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ON THE RELATION BETWEEN ANXIETY AND CONDITIONING[1]

DALBIR BINDRA, ALAN L. PATERSON
AND
JOANNA STRZELECKI
McGill University

THAT anxious and nonanxious subjects, separated on the basis of scores on the Taylor Anxiety Scale, perform differently in a simple eyelid-conditioning situation seems now well established (**2, 9, 11, 12**). But the interpretation of the observed differences still remains an issue. The Iowa group, Taylor, Spence, and Farber (**9, 10, 11, 12**), working within Hull's formulation (**4**), attribute the greater amount of eyelid conditioning obtained in anxious subjects to the presence of greater effective drive strength. Drive strength (D) is assumed to be a function of the level of the subject's emotionality, and emotionality in turn is assumed to be greater in anxious than in nonanxious subjects. An alternative explanation is to be found in a paper by Hilgard, Jones, and Kaplan (**2**). They state that anxious subjects, being more apprehensive, look on the CS for eyelid conditioning (air puff) as a threatening stimulus. And since the eyelid response is defensive or protective, anxious subjects are likely to make the eyelid CRs more readily than nonanxious subjects. It should be noted that both the Iowa group and Hilgard *et al.* attribute the observed differences in simple conditioning to differences in drive, but whereas the former look upon the anxiety-linked drive as contributing to and becoming a part of the total general D, the latter seem to think in terms of a specific and distinct defensive drive.

One way of testing the alternative hypotheses is by determining whether or not the positive relation between anxiety and the amount of conditioning holds when the response to be conditioned is not the defensive eyelid response, but a non-defensive response, such as salivation. If the interpretation of the Iowa group in terms of a general D is correct, we should expect that the salivary CRs also will be made more readily by anxious than by nonanxious subjects. If, on the other hand, the specific defensive-drive interpretation of Hilgard *et al.* holds, we should expect to find no such differences in a simple salivary-conditioning situation. The following experiment was designed to test these opposed theoretical deductions.

[1]This study was supported in part by a research grant (A.P. 12) from the National Research Council of Canada.

METHOD

Subjects. The Ss were selected from undergraduate psychology courses on the basis of their scores on the Taylor Anxiety Scale (**12**), administered to the classes about six months prior to this experiment. The anxious group consisted of 15 Ss with a score range of 19 to 34, whereas the scores of the 15 nonanxious Ss ranged from 4 to 16. There were 10 female and 5 male subjects in each group.

Method of measuring salivation. In general our procedure was the same as that used by Razran (6). A cotton roll, roughly .35 by 1.5 inches (Johnson and Johnson, No. 2), was put in a waxed paper envelope and weighed. Then the roll was placed under S's tongue for the desired time, removed and put in the envelope, and weighed again. The increase in the weight of the roll due to absorption of saliva was taken as the measure of salivation.

Procedure. Ss were instructed not to eat anything for at least four hours prior to the experiment. On arrival in the experimental room, Ss were misinformed regarding the purpose of the experiment, being told that it was designed to find out the effects of external stimulation upon digestion. "During the course of the experiment you will be submitted to various stimulations, such as reading, eating, and sounds. Samples of your digestive juices will be taken by means of the dental cotton rolls inserted in your mouth. Here is a magazine (*Coronet*) which you must look through or read during the experiment."

An ordinary door bell was used as the CS, and a lollipop on a stick as the UCS. The experimental procedure can be divided into three parts: control series, conditioning series, and extinction series. In each of the six *control* trials a cotton roll was placed in S's mouth, and after 15 seconds the CS was presented for 30 seconds. After another 15 seconds the cotton roll was removed from the mouth and weighed. Thus each control trial took one minute. The *conditioning* series consisted of 40 conditioning trials and 5 test trials; one test trial was given after every 8 conditioning trials. S was given a lollipop, and was instructed to put it in his mouth and start sucking it when the bell rang (CS) and to keep on sucking until the bell stopped ringing. The CS was presented for 30 seconds. Cotton rolls were not used in the conditioning trials, but were, of course, used in the 5 test trials. The procedure for each test trial was the same as that for the control trials, that is, the CS was not followed by the UCS. The lollipop was taken away from S after the last test trial. The *extinction* series consisted of 15 trials which were also exactly like the control trials. The inter-trial interval was roughly 1 minute. The interval between the control series and conditioning series was 2 minutes,

and between conditioning series and extinction series, 5 minutes. The whole procedure took about 2.5 hours.

Two *Ss*, separated by a screen, were tested at a time.

Results

Table I shows, for the anxious and nonanxious groups, the means and *SD*'s of the mean amounts of salivation for: (*a*) the 6 control trials, (*b*) the 5 test trials and (*c*) the 15 extinction trials. It is clear that the differences between the groups are quite insignificant.

Curves of acquisition and extinction of the CR for the two groups are presented in Figure 1. An inspection of the curves reveals no systematic difference in the rate of acquisition or extinction between the anxious and nonanxious groups.

TABLE I

Amount of Salivation (in grams) in Control, Test, and Extinction Trials for Anxious and Nonanxious Groups

	Control trials (6)		Test trials (5)		Extinction trials (15)	
Group	Mean*	S.D.	Mean*	S.D.	Mean*	S.D.
Anxious	.83	.44	1.18	.67	1.07	.53
Nonanxious	.81	.42	1.24	.56	1.04	.51

*This represents the mean of the mean amounts of salivation for *Ss* in each group.

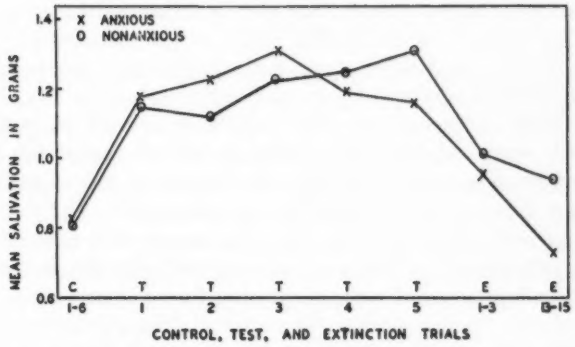

Figure 1. Curves of acquisition and extinction showing the mean amount of salivation during control, test, and extinction trials for the anxious and nonanxious groups.

Discussion

Since the results do not show any difference whatsoever between the anxious and nonanxious subjects in a salivary conditioning situation, it is clear that the interpretation of the Iowa group, at least in its present form, is not correct. It will be recalled that the Iowa group attributes the positive relation between anxiety and eyelid conditioning to a higher level of *total D* operating in anxious subjects. On the other hand, the present results are consistent with the interpretation of Hilgard *et al.*, who postulate a higher level of *specific defensive drive* in anxious subjects. In this connection it is important to note that previous investigators, who found a relation between anxiety and the conditioning of a response other than the eyelid response, nevertheless used a threatening UCS and a response that is easily evoked by a threatening stimulus. Both Bitterman and Holtzman (1) and Welch and his collaborators (7, 13) used electric shock as the UCS and GSR as the response. To our knowledge no investigator has found a relation between anxiety and the conditioning of a non-defensive, "positive" response, such as salivation.

Assuming that Hilgard's specific "defensive" drive does exist, and that its level is higher in anxious than in nonanxious subjects, two further questions arise: 1. What is the exact nature of this drive? 2. What exactly is the mechanism by which this drive affects the rate of conditioning? Unfortunately, Hilgard *et al.* are not explicit enough in their interpretation to provide a satisfactory answer to these questions. We must turn elsewhere for this.

Recently, Meyer (5) has argued that the observed relation between frequency of conditioned eye blinks and anxiety is not due to a difference in conditioning as such, but can be accounted for in terms of a greater "facilitation" of the eyelid reflex in the anxious *Ss*. He cites evidence showing that induced muscular tension and emotional excitement increase blink rate, and argues that high scores on the Taylor Anxiety Scale represent an "unusual amount of muscular activity" (5, p. 215). We cannot fully accept Meyer's explanation, though we agree with him that muscular tension is a factor of major importance in the experiments on the relation between eyelid conditioning and anxiety. We believe that Meyer is correct only if he is interpreted as saying that anxious subjects are *potentially* more tense than nonanxious, and that this difference becomes evident *only* under stress. Assuming this, our answer to the first question above, which concerns the nature of Hilgard's defensive drive, is simply that the so called defensive drive *is* a high degree of muscular tension, and that in a threatening situation a high degree of muscular tension is more readily evoked in subjects classified as anxious than in

those classified as nonanxious. That is to say, anxious subjects are likely to become muscularly more tense in a threatening situation, and this muscular tension acts as a drive. Thus, in the eyelid conditioning experiments, since a threatening UCS was used, there existed a substantial difference in the muscular tension of the anxious and nonanxious subjects. On the other hand, in the present experiment, since no threat or stress was involved, differences in muscular tension between the two groups were nonexistent, or at least, minimal.

Again, in the light of studies so far published, we do not agree with what is likely to be Meyer's answer to our second question: What is the mechanism by which muscular tension affects the amount of conditioning? Meyer states, in essence, that in the anxiety-eyelid conditioning experiments the investigators have not obtained differences in true conditioning but only in the frequency of eye blinks. That is, he attributes the results of Taylor, Hilgard *et al.*, Spence, and Farber, at least partly to pseudo-conditioning or sensitization as traditionally described (3). We find it hard to accept such an interpretation because those investigators do not mention any sensitization effects, although they were apparently aware of this problem. Spence (8, p. 57) in particular has taken pains to point out differences between conditioned eyelid responses and voluntary eye blinks. It is possible that Meyer's interpretation is correct on this point also, but unless a more stringent experimental test, controlling the factor of sensitization, supports him, the reported evidence remains in favour of a relation between anxiety (evoked muscular tension) and true eyelid conditioning. Whether increased muscular tension can also affect the amount of salivary conditioning remains to be investigated.

Summary

Hilgard, Jones, and Kaplan attribute the more rapid eyelid conditioning in anxious, as compared to nonanxious, subjects to the presence of a higher degree of a specific defensive drive in anxious subjects. Taylor, Spence, and Farber, on the other hand, explain it in terms of a higher general drive-strength (Hull's D) operating in anxious subjects. The present experiment tested these opposing hypotheses by determining whether or not the positive relation between conditioning and anxiety held when the response to be conditioned was not the defensive eye blink, but a non-defensive response, salivation.

Anxious and nonanxious subjects, separated on the basis of the Taylor Anxiety Scale, were tested in a salivary conditioning situation, with a bell as the CS and a lollipop as the UCS. No difference in the amount or rate of conditioning between the two groups was found.

The results are interpreted in terms of an extension of the view of Hilgard *et al.* The basis of the relation between anxiety and eyelid conditioning is discussed.

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THE TORONTO COMPLEX COORDINATOR[1]

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THE Toronto Complex Coordinator was developed as the first of three units designed for the study of perceptual-motor performance. In many aspects, this unit is similar to the Modified Mashburn Apparatus (1) developed at the State University of Iowa. It differs from the Iowa apparatus in complexity of tasks, in nature and number of performance measures available, and in flexibility of control-display relationships.

BASIC FEATURES OF THE APPARATUS

As will be noted in Figure 1, the display panel consisted of 81 double-light assemblies arranged in a square block of 9 rows and 9 columns. The middle of the square was located approximately at the eye level of the seated subject. A double-light assembly consisted of a central green light encircled by a ring-shaped red light. Separate electrical circuits for the red and green lights permitted the green disk and the red ring to be lighted independently. When the apparatus was operating, only one red and one green light were lighted. The particular red light illuminated was determined by the position of a 50-position stepping-switch. The location on the panel of the lighted green light was determined by the subject's manipulation of two controls. These are shown in Figure 1 as simulated airplane aileron and elevator controls.

At the beginning of a practice period, one red light was presented on the panel. The control-unit (the control stick) operated the horizontal and vertical movement of the green disk in such a manner as to move the green disk within the lighted red light. When the green light was held within the red circle for a period of .30 seconds, an automatic stepping-switch caused the red circle to appear in a new position. The subject continued to locate the green light within subsequent red circles. In this situation, maintaining the green light within the corresponding red light for a period of .30 seconds was referred to as a "match." One measure of performance was the number of matches made during a given practice period.

Control-display relationship. The apparatus was designed to provide maximum flexibility in control-display relationships. The direction of the apparent movement of the green light was determined by independently changing its horizontal and vertical coordinates by means of two separate controls. The connections between the display mechanisms operating the vertical and the horizontal components and the two controls manipulated by the subject were through two selsyn systems. This linkage permitted the use of any type of controls that could be made to rotate the control selsyns.

The control stick shown in Figure 1 combines two separate control systems: right-left movements of the stick constitute the operation of one control, and movements toward or away from the operator the operation of the other control. Diagonal

[1]This study was conducted at the University of Toronto under Research Grant No. 265 from the Defence Research Board of Canada.

movements activate both control systems simultaneously. For any pair of controls such as these, there are several control-display relationships possible. The controls could be linked to the display, for example, so that a movement of the stick to the right would move the green light to the right, to the left, to the top, or to the bottom of the panel. Thus, each control would be related to either the up-down or the right-left movement of the green light on the display, in such a way that a movement of the control in a given direction could move the green light in either of two opposite directions. Any particular linkage between the two controls and the display was referred to as a "task." It was thus possible for the subject to practise on different tasks with the same controls and display. Additional tasks could be obtained by similarly connecting this stick control to different displays (not reported here), or by arranging for different controls (not reported here) to operate this light display.

Measures of performance. To provide a detailed description of performance on this apparatus, several aspects of performance were recorded. Earlier studies had shown that number of errors and length of time that errors persisted (**2**) were significant measures. It was suspected that these and certain additional measures might prove significant and useful for a more comprehensive understanding of human perceptual-motor phenomena.

Ten distinct measures were obtained during each practice period; six were recorded on electromagnetic counters, and four on Standard Electric time clocks. An automatic system for presenting a ready signal and for timing practice and rest periods also provided a method whereby longer practice periods could be recorded in terms of successive 20-second intervals. A cam, driven by a synchronous motor, switched the time measures from one bank of counters and clocks to a second bank of similar counters and clocks every 20 seconds throughout the practice period. The experimenter was then able to read one set of measures while the second set was recording. Because of this basic recording period, all practice sessions were a multiple of 20 seconds in length. A period of practice one minute in length, for example, was recorded as three periods of 20 seconds each. It was felt that records of this shorter length would indicate characteristic changes in performance occurring during the longer one- or two-minute practice periods.

In addition to the number of matches, the number of times that the green light was located in the appropriate red light was recorded. This was described as the "hit" score. The hit score could never be less than the match score since a match was, in essence, a hit which had been maintained on the target for a period of .30 seconds. The hit score is a partial indicator of the precision of response upon reaching the red light toward which the green light is being moved. This score would be determined by responses such as overshooting the target or general lack of stability in control manipulation.

When considered by itself the hit score may not be too meaningful, since its absolute value is partly determined by the value of the number of matches. Relative to the hit score, the match score indicated the smallest number of hits possible during a particular practice period. A hit score of 9, for example, indicated a characteristically different performance when the match score was 9 than when there were three matches. Together the match and hit scores form a ratio indicating the precision of performance.

For each control (horizontal and vertical) four measures were taken; the number of initial errors, the total number of errors, the amount of time that the total errors persisted, and the time elapsing between the completion of one match and the beginning of the movement of that control to make the next match. Immediately

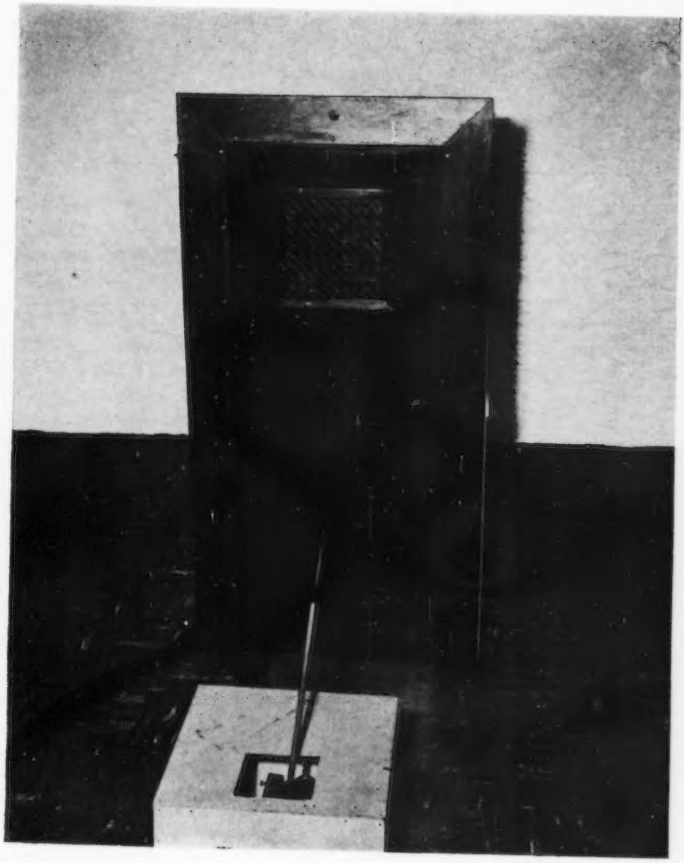

FIGURE 1

after a match was made, a new red light appeared on the panel. The automatic change of red lights was so rapid that the subject was unable to move either control from the position of the immediately preceding match. It was thus possible to record the initial movement to the new red light. An initial movement of either control in a direction away from the new stimulus light counted an initial error for that control. When the initial movement for a given control was toward the stimulus light, an initial error was not possible until the period immediately following the next match. The independent operation of the two initial error-counting circuits made as many as two and as few as zero errors possible on each match. After a practice period, the maximum number of initial errors on each control was equal to the number of matches.

Since number of initial errors was so closely related to number of matches, a ratio of number of initial errors to number of matches was generally computed.

While a subject might initially move a control toward the new stimulus light and thus avoid making an initial error, he would frequently move the control in a direction that increased the distance between the green and red lights before making a match. All movements of the controls, including the initial movements, that were in a direction that increased the distance between the red and the green lights were recorded as errors. These errors were termed "total errors." As with initial errors, an independent record of total errors was obtained for each control. The possible relationship between initial errors and matches does not hold for total errors and matches. A total error score ranging from zero to some very large value determined by the speed of operation of a relay could conceivably be associated with any match score. The construction of the apparatus determined no necessary relationship between number of total errors and number of matches. A ratio of number of total errors to number of matches would not have the same precise meaning as the ratio of number of initial errors to number of matches. However, it did seem that a low total error score associated with a low match score represented a characteristically different performance than the same total error score associated with a high match score. For this reason a ratio of number of total errors to number of matches was computed.

In addition to counting initial and total errors, latency of control movement after each match and persistence of total errors was measured for each control. When a match was made and the next red light was automatically presented, two clocks were activated. Moving one control in either direction from the position of the previous match stopped one clock, and moving the other control similarly stopped the other clock. This measure is referred to simply as "latency." The clock, once stopped, would remain inactive until the next match, at which time it would again be activated and stopped by a control movement. This sequence continued throughout the practice period. A movement that was in essence an error served to stop the clock just as well as one that moved the green light toward the red light. Latency measures were cumulated over a 20-second period. Since latency was clearly related to number of matches made during a practice period, an average latency was computed by dividing the cumulated latency by the number of matches for a given practice period.

It had previously been shown (2) that the length of time that errors persisted was a significant measure for the study of perceptual-motor performance. This measure was obtained separately for each control by arranging to have a clock start whenever an error was initiated and stop when the erroneous control movement stopped. A total of this measure for all errors occurring during a 20-second interval divided by the number of total errors provided an average persistence of error for that period.

Apparatus Construction

The detailed features of the electrical circuits employed will not be described. It is enough to give a general notion of the method. The position on the panel of the red light was determined by the way in which one pole of a 50-position stepping-switch was wired. For each position on the stepping-switch, additional poles were used to activate the stepping-switch when the appropriate green light was lighted, and to indicate initial and total errors and persistence of errors for that particular red light. Each position was wired differently in accordance with the relative positions of the red light presented and of the red light matched prior to it.

Although a pattern of potential matches and errors was wired into the apparatus, the actual activation of the counters and clocks was finally dependent on the subject's movements of the controls. Each control directly operated a selsyn generator. The selsyn motor moved in phase with the corresponding selsyn generator as it was rotated by its control. For each control circuit, a delicately balanced friction bar on the shaft of the selsyn motor carried a mirror which reflected a beam of light up to a photocell or down to another photocell according to the displacement of the bar on either side of the match or centre position. Activation of a photocell served to operate a relay associated with it through a thyratron tube and thus to differentiate the two directions of movement of the control. An electromagnetic centring device centred the friction bar after each match and also limited the amount of its rotation on either side of centre. The interaction of the circuits related to the movements of the controls and the stepping-switch circuits associated with the display together determined the activation of the recording units.

Sample Results

The manner in which these measures change with a change of a relevant variable can be illustrated by considering the performance of two groups on the same task under different conditions. Each group was composed of 10 male sophomores. Group 1 practised a task (Task A) in which a movement of the stick to the right moved the green light to the right and pulling back on the stick moved the green light down. Each of the subjects in Group 1 practised continuously for 20 minutes. The task, conditions of practice and length of practice period were the same for the subjects in Group 2, with the exception that practice on Task A was preceded by 20 minutes of continuous practice on a different task (Task B) on each of the two days immediately prior to practice on Task A. To move the green light in Task B the subject had to move the controls in directions opposite to those required in Task A; movement of the stick to the right moved the light left, movement back moved the light up.

The performance of the two groups on Task A is shown in Figure 2. "Trials" on the base line represents 60 successive 20-second practice periods rather than separate trials. However, since these groups were subsequently compared with similar groups which practised under more distributed conditions, the term "trials" seemed more appropriate. In

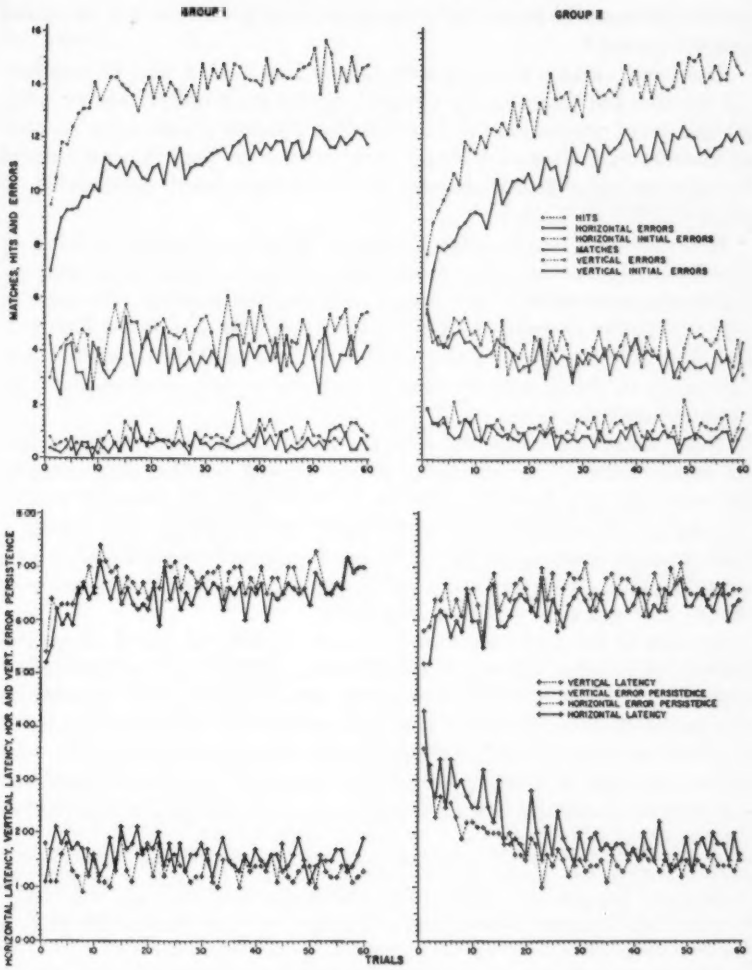

FIGURE 2

the top half of the graph six counting-measures for the two groups are represented, while at the bottom half four time-measures are shown. In traditional interference terms, Group 1 practised on Task A as original learning (OL) and Group 2 practised on Task A as interpolated learning (IL) following two days of practice on Task B as OL. Each plotted

point represents the mean performance for 10 subjects during a 20-second practice period.[2]

The initial mean performance for Group 2 on Task A was 5.8 matches, 1.2 matches less than that for Group 1 on the same task. However, after 20 minutes of practice, both groups made approximately the same number of matches in a 20-second period. Performance on Task A, as measured by number of matches, showed an initial decrement attributable to prior practice on Task B.

Hits showed a trend similar to that of matches, a smaller number of hits for Group 2 at the outset of practice on Task A increasing to approximately the same number as Group 1 at the end of practice. The ratio of hits to matches changed during practice from 1.35 to 1.25 for Group 1, and from 1.33 to 1.25 for Group 2. On the basis of these ratios, the performances of the groups, in terms of hits per match, were regarded as approximately the same.

Mean values for horizontal total errors for Group 1 fluctuated about 4.0 errors, showing no systematic change during practice. For Group 2 the mean changed from about 5.6 to 3.7 total errors for the same period of practice. During practice, vertical total errors increased for Group 1 from a mean of about 3.0 to 5.0 total errors, but decreased from about 5.4 to 3.7 total errors for Group 2. Once again, a change in the measures due to prior practice on Task B was noted.

Because of the close relationship between number of initial errors and number of matches, latency and number of matches, and persistence of error and number of errors, the initial errors, latency, and persistence of errors will not be discussed as unique scores. The means for horizontal and vertical initial errors for the two groups are indicated near the base lines in the upper half of Figure 2. Means of latency and error persistence for the horizontal and vertical controls for the two groups are plotted

[2]Mention should be made of the slope or the change of rate of performing with successive 20-second periods of these curves. Whether learning, as manifest by performance, proceeds as a continuous function of time spent practising, or as a step-function with increments following the occurrence of some phenomenon such as reinforcement, one of the factors determining the absolute amount of change in learning from one practice interval to the next will be the length of the unit practice interval. Any number used to represent rate of performing is, in a sense, an average for that interval. The rate may have been much slower at the beginning than at the end of the interval. The longer the interval over which performance on this type of task is cumulated, the more masking there is of these subtle changes during practice. However, as may be noted in Figure 2, the shorter measurement intervals resulted in less stable data than would be obtained by combining several shorter intervals into one longer interval. The shorter intervals were retained in view of a belief, later confirmed, that some characteristic changes in performance occurred very rapidly during performance.

in the lower half of Figure 2, the respective curves being indicated in the legend.

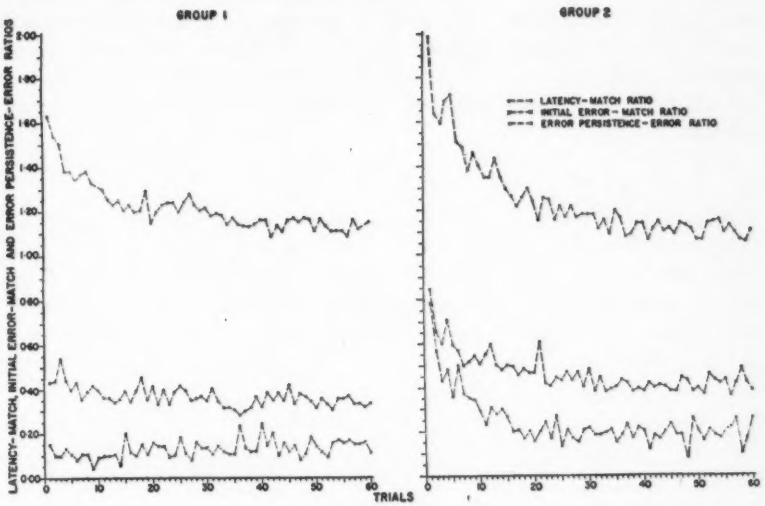

FIGURE 3

In Figure 3 the relevant ratios are shown for the 20-minute practice period on Task A. For simplicity, the ratios were computed by combining the measures for the two controls for each subject before calculating the value of the individual ratios. The mean latency-match ratio for Group 1 decreased from about 1.63 to 1.15, a difference of 0.48, whereas for Group 2 it decreased from about 2.00 to 1.10, a difference of 0.90. Prior practice on Task B resulted in a higher latency-match ratio at the beginning of practice on Task A, but the difference disappeared at the end of practice. The ratio of error persistence to total error decreased slowly for Group 1 from about 0.43 to 0.34, while it decreased more rapidly for Group 2 from about 0.85 to 0.44. Group 1 showed a change in this ratio of 0.10, while Group 2 showed a change of 0.41. No systematic trend was noted for the initial error-match ratio for Group 1; it fluctuated about 0.15. For Group 2 a steady decrease was noted in the initial error-match ratio from 0.78 to 0.25, a difference of 0.53. Neither the ratio of error persistence to total error nor the ratio of initial error to matches for Group 2 reached as low a level at the end of practice as did the same ratios for Group 1.

Characteristic differences between the curves for the two groups on

Task A can be reasonably attributed to prior practice of Group 2 on Task B. Differences in levels and shapes of the curves for mean number of matches, latency-match ratios, initial error-match ratios, and error persistence to total error ratios indicate that this apparatus will be useful in the study of aspects of the interaction of habits. The flexibility of controls, displays, and control-display relationships provides a method by which transfer effects between habit tendencies can be systematically studied.

Summary

A perceptual-motor task having ten measures of performance was described. One of the main features of the apparatus, besides its several measures, was the flexibility of the control-display relationships. Data were provided to indicate the manner in which the measures changed as a result of performance on a prior task involving reversed movements of the controls.

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PERSONALITY AND OCCUPATIONAL ADJUSTMENT: A CROSS-VALIDATION STUDY[1]

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In a previous paper (3) the writer reported the results obtained by the use of objective tests of general mental ability, emotional stability, and temperament with unskilled factory workers. One defect of that paper was the absence of cross-validation data; this was unobtainable in the circumstances, but its lack made evaluation of the findings difficult. A later project in a series planned to investigate the relationship between psychological and occupational handicap provided an opportunity to improve on this unsatisfactory outcome. The present paper reports the use of a somewhat unorthodox procedure for the reduction of error variance as a preliminary to multiple correlation and the use of what the late Charles Mosier called (5) "the double cross-validation technique."

Samples

The samples originally consisted of two groups of 105 each, drawn at random from men who had just been accepted for training as omnibus conductors in a large industrial city. Those selected were all between the ages of 17 and 45, and without previous experience as conductors or drivers. These men were given a large battery of individually administered tests, of which full details appear in a doctoral thesis by Venables (6) which will be published as articles. The men were then followed up until they had completed a minimum of 26 weeks service at their garages after completion of training, or until earlier discharge or resignation. Of the two groups of 105, 78 and 66 men respectively stayed the minimum period, and are consequently included in the present study. These two groups did not differ significantly in age or intelligence.

Establishment of Criteria of Occupational Success

Full details of these criteria appear elsewhere, but enough particulars must be given here to indicate their suitability for the purpose.

1. *Criterion of Job Satisfaction* (4). During the course of a structured 30-minute interview with each man the writer administered a 15-item job-satisfaction inventory, based on extensive enquiry and anonymous

[1]The author wishes to acknowledge with gratitude the helpful criticisms of Dr. F. W. Warburton and of Mr. Arthur Summerfield in preparing this report. It was presented in condensed form at the annual meeting of the American Psychological Association in New York, September 4, 1954.

personal experience as a trainee conductor. The inventory was administered first in graphical form and then in multiple-choice form (using five descriptive phrases per item, in randomized order of favourableness). Marked differences in response to the same item by the two methods of presentation formed the basis of free discussion, leading after clarification of meaning to an opportunity for the subject to alter one or both of his responses. Factor analysis was used to investigate the areas of satisfaction, and unit-weight multiple correlation (with the relevant factors) to select 10 items which were united in a composite job-satisfaction score. They correlated with the general factor .80; the average reliability of the 10 items was .70, which means, of course, that the reliability of the composite score is considerably higher. This criterion showed a slight linear correlation with age ($+.178$, $P = .05$). The ten selected items appear in Table I.

TABLE I

SELECTED ITEMS FORMING A COMPOSITE SCORE OF JOB SATISFACTION ARRANGED ACCORDING TO GROUP FACTORS

Group factor*	Item	Loading on relevant group factor**	
A1 Intrinsic liking for the job itself	How do you like the kind of work that you do?	.46	
	How interesting is this job?	.41	(.49)
	How do you like your job?	.39	
A2 Satisfaction with present employment	How do you feel you have got on since coming here?	.49	
	How does . . . compare with other places as a place of work?	.42	(.55)
B1 Aspirations and adjustments	The hours on this job . . .	.46	
	How much does your job give you a chance to do the things you are best at?	.37	(.50)
2 Acceptance of pressures	How tired are you at the end of the day?	.55	
	During peak hours a conductor has to work . . .	.50	(.66)
	My mates think this job is . . .	.31	

*A1 and A2 are regarded as together representing *positive* elements of satisfaction, B1 and B2 as representing *negative* elements ("putting up with").

**Figures in parentheses are the unit-weight multiple correlations of the selected items with the group factor.

2. *Criterion of "Value to the Employer"* (4). This was a composite based upon an unweighted combination of the following variables:

(*a*) gross earnings including overtime;
(*b*) cash shortages on ticket sales;
(*c*) number of times late for duty;
} totals for 26 weeks

(*d*) normalized 5-point grading by three supervisors of "the extent to which the man was a source of concern." (2)

These four items, using unit weights, correlate with the general factor .86. It should be noted that "gross earnings" is in this particular job a direct measure of the *availability* of the man to the employer, as the smooth operation of a 24-hour service not arranged on a fixed-shift system requires a large amount of voluntary overtime from most of the men. The composite criterion score correlated +.522 with age.

Statistical Analysis

The variables available were 23 in number, comprising age, training school chief instructor's rating, a psychiatrist's rating of "recent mental health," 18 psychological test scores, and the two criteria described above.

1. For each group separately, product-moment intercorrelations were computed to produce two independent 23 × 23 matrices.

2. The next step was to obtain partial correlations between the two criterion variables and the 20 personality variables with age held constant, wherever this was necessitated by a significant correlation with age.

3. A table was prepared listing the correlation coefficients obtained between each criterion and all the personality variables in each of the two groups of subjects. (A small section of this table is shown in Table II.)

No entry was allowed to remain in a cell unless all three of the following requirements were met:

(*a*) signs the same in both groups;
(*b*) the smaller *r* of the pair not less than the *SE* of zero *r* for the appropriate *N*;
(*c*) the product of *P*s of the two *r*s not greater than .02.

The object of applying these three requirements was explicitly to avoid the wasted labour of lengthy computation of multiple *R*s on two small samples, with large numbers of small coefficients that might represent little but error. It is realized that they are somewhat arbitrary; for example, significance at the .05 level could have been demanded of all *r*s. There is also a slight risk that a suppressor variable has unwittingly been discarded.

TABLE II

ILLUSTRATIVE PORTION OF TABLE PREPARED TO FACILITATE SELECTION OF VARIABLES AS DESCRIBED IN TEXT

(Of the variables shown in this extract, only two (coefficients shown in bold-faced type) were selected; all others were rejected for failure to meet one or more of the requirements described in the text.)

Personality variable	Group	Correlations with criteria	
		Job satisfaction	Value to employer
a	A	+.072	+.207
	B	−.185	−.029
b	A	**−.150**	−.055
	B	**−.209**	−.018
c	A	+.093	+.189
	B	+.096	+.055
d	A	**+.255**	+.155
	B	**+.227**	+.107

4. The procedure outlined above eliminated all but four of the personality variables, and, since none of these involved the criterion of "Value to the Employer," concentrated attention upon "Job Satisfaction."

5. Separate multiple *R*s were computed for each of the two groups of subjects and, following Mosier's suggestion (**5**), the regression coefficients obtained from one group were used with the other and vice versa. The two multiple *R*s were then averaged to give the final figures. The relevant data appear in Table III. (Age was partialled out of all intercorrelations before setting up this table.)

The data used to determine the four remaining personality variables were as follows:

1. A 40-item neuroticism inventory, devised by the writer for industrial use and administered by a new method.[2]

2. A factor score, based on five tests reported by Eysenck (**1**), all of which in this study obtained low loadings on a general factor resembling his "neuroticism," and were contrasted by another (bipolar) factor with three questionnaire measures, one of which was the first variable just described.

[2]Details are available in mimeographed form to those interested in using the inventory and the method for research purposes only.

TABLE III

INTERCORRELATIONS, REGRESSION COEFFICIENTS, AND MULTIPLE R, FOR PREDICTION OF JOB SATISFACTION CRITERION, USING THE DOUBLE CROSS-VALIDATION TECHNIQUE

	Group A (N = 78) Personality variables*				Group B (N = 66) Personality variables			
	1	2	3	4	1	2	3	4
2	.070				−.015			
3	.020	.089			.161	−.083		
4	−.025	.171	.026		.033	.049	.028	
Crit.	.255	.219	.151	.150	.227	.178	.234	.209
Regr. coeffic.**	.245	.170	.128	.123	.189	.189	.214	.188

Multiple R^2	
Group A, using Group B regression coefficients	.150
Group B, using Group A regression coefficients	.142
Average multiple R^2	.146
Average multiple R (N = 144, P = .01)	.38

*For details of personality variables, see text.
**Obtained by method of pivotal condensation.

3. One of the measures obtained from a test of task-induced "experimental stress," designed by Venables (**6**).

4. A factor score, based upon five tests which gave low loadings on a bipolar factor resembling Eysenck's "hysteria vs. dysthymia" (**1**) (correlation with "Job Satisfaction" negative when scored for "hysteria").

DISCUSSION

This was *not* a study designed to produce good predictors of success in omnibus conducting. If this is clearly understood, the value of the results is easier to appraise, in terms both of method and of practical use. A second point is that the two groups for whom the criteria became available were highly selected, since the men had stayed 26 weeks in a job in which the labour turnover was 31 per cent of the entry. Had the writer not been interested in finding out what connection, if any, existed between personality variables and criteria of occupational success among those who *stayed*, this study would not have been carried out. Similarly, the correlation between age and success had to be controlled, since so far as the objectives of the study were concerned it was irrelevant and confused the picture.

It is worthy of note that among a group of occupationally stable men there appears to be a small but clear connection between tendencies to neurotic instability and lack of job satisfaction, but none between these tendencies and a broadly based criterion of "Value to the Employer."

On the methodological side, the use of two independent sub-groups, drawn simultaneously, to permit a somewhat unorthodox procedure for the selection of variables and a subsequently simple application of the double cross-validation technique is perhaps not without interest. When one considers the difficulty of evaluating a conventional multiple *R* based on a single, highly self-selected sample of 144 (78 + 66), with no hope of repeating the investigation, the approach may commend itself to the attention of industrial psychologists and others. In view of the possibility that the method used to select stable variables may to some extent render unnecessary the use of the double cross-validation technique, it would be particularly valuable to obtain data from studies similarly designed but having a smaller number of independent variables, which would permit direct comparison of the effects achieved by the two procedures.

Summary

1. This paper describes the use of two unorthodox techniques as an economical means of obtaining a statistically reliable estimate of the multivariate relationships between a battery of personality measures and criteria of occupational success.

2. The two groups involved consisted of 78 and 66 men respectively, all of whom had stayed 26 weeks as omnibus conductors, without previous experience.

3. After holding constant the effects of age, significant and stable relationships were shown to exist between a criterion of job satisfaction and certain personality measures, in spite of the restricted range of the population available for study.

4. The methods used seem to have justified their further use by research workers in the applied field.

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ELECTROMYOGRAPHIC GRADIENTS IN GOAL-DIRECTED ACTIVITY[1]

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THERE are only a few studies of the time course of muscular activity during psychological tasks. Except for incidental observations, previous studies usually sampled changes in muscle tension from a "resting" to an average working level (1). Such studies demonstrated that performance is accompanied by higher muscle tension, even in "mental work" (e.g., mental arithmetic, memorization).

Three studies indicated that muscular activity, measured as electromyographic potentials (EMGs), may increase progressively during "mental work" (3) and during mirror tracing (6, 7). The term EMG gradient is suggested to refer to such a progressive rise in muscle tension, which begins with initiation of task and continues to the end of the task.

Firstly, Davis (3) observed a "build-up" in EMGs from right forearm during mental arithmetic. However, a progressive increase in task difficulty apparently accompanied the EMG rise. It was not known, therefore, whether this incidental observation of a "build-up" could be duplicated under test conditions of equal task difficulty throughout. Secondly, Malmo *et al.* (6) described qualitatively a tendency for EMGs to increase progressively during mirror tracing. This observation was incidental to the main purpose of their experiment, so that their conclusions were perforce limited. Thirdly, Smith (7) obtained some quantitative evidence for EMG gradients in active forearm extensors during mirror tracing.

Left unanswered was this methodological question, with implications for theory: How are these EMG gradients during mirror tracing[2] related to drawing speed? No data were available on this point. Evidence for speed gradients in maze running, interpreted as reflecting approach gradients (4), suggested that there may be similar gradients in drawing speed. Therefore, drawing speed was now measured to see whether

[1]This investigation was supported by the Medical Research and Development Division, Office of the Surgeon General, Department of the Army, under Contract No. DA–49–007–MD–70. This report is part of a dissertation submitted in partial fulfilment of the requirements for the degree of Master of Science in the Department of Psychology, McGill University. It was read at the Annual Meeting of the Canadian Psychological Association, Kingston, Ontario, May 1953. The advice and assistance of Dr. Robert B. Malmo are gratefully acknowledged.

[2]Other research was subsequently designed to determine whether EMG gradients occur during attentive listening (8, 9).

EMG gradients in mirror tracing depend on simultaneous gradients in drawing speed.

Implications for the psychological interpretation of EMG gradients are present in the following data. Smith (7) observed greater maintenance of muscle tension after task interruption than after task completion. This and other evidence on completed and interrupted tasks supports Lewin's suggestion of a hypothetical "tension system," characteristic of motivated activity, which tends to persist after task interruption (5). It is interesting therefore that degree of sustained muscle tension after task interruption correlated positively ($\rho = .60$; $N = 15$) with average magnitude of EMG gradients for *all* tasks combined (7). This finding suggests that EMG gradients may reflect the subject's motivation to do the task. Because this correlation was based on a small number of subjects, further confirmation was required.

The present objectives, therefore, were to study EMG gradients in mirror tracing by: (*a*) obtaining original data on drawing speed as a control for interpreting EMG gradients; and (*b*) investigating further the relation of EMG gradients to the task-interruption effect.

Methods

Subjects.[3] Ages of the 17 male Ss ranged from 18 to 37 years, with a median of 23. Years of completed formal schooling ranged from 8 to 12, with a median of 9 years. The Ss were not familiar with the psychological literature on interrupted tasks.

Tasks. Subjects traced figures screened from direct vision but visible in a mirror. Four figures were used: small circle, large circle, small square, and large square (see Figure 1). Circumferences of the two smaller figures (always used as completed tasks) were 26 cm., and of the two larger figures (always interrupted) 31 cm. Point of interruption was 5 cm. from the goal, so that S drew the same distance in both completed and interrupted tasks. Tracings were in a clockwise direction for circles, counterclockwise for squares. This procedure compensated for differences in the hand's terminal position in completed and interrupted tasks. Goal point of small circle and interruption point of large square approximately coincided; and similarly for the opposite pair. The tasks were presented in a different, random order to each S.

EMG recording apparatus. Muscular activity was measured as electromyographic potentials (EMGs) between bipolar surface electrodes, amplified and recorded continuously on an Offner Type D, ink-writing electroencephalograph (2). Vacuum tube integrators using the condenser-charge principle were connected in parallel with the EEG recording pens. All measurements of EMGs were made on the integrator records. The integrator recording system was linear with respect to voltage input for pen deflections between 2 mm. and 25 mm. Most of the measured EMGs were within this linear range. Primary records were used to eliminate samples with artifacts, such as electrocardiograms and "60-cycle" artifact. Recordings were taken from standard placements over extensors and flexors of the active forearm, and from chin (2).

[3]The author wishes to thank the Royal Canadian Air Force personnel who served as Ss and the officers who assisted with arrangements.

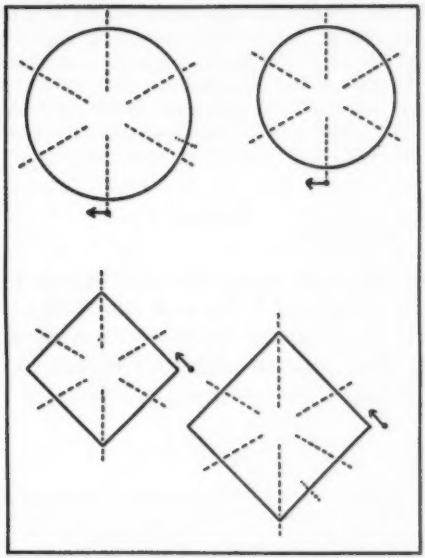

FIGURE 1. Task material. Dashed lines indicate concealed slots for "on–off" photoelectric cell signals. The short dotted lines show points of interruption.

Drawing speed recorder.[4] An otoscope lamp was attached to the drawing pencil and connected to two 1½-volt batteries in series. The pencil light was switched on during drawing periods. It shone through the drawing paper and a glass plate. The lower side of the glass plate was covered with a sheet of thick black paper, which absorbed most of the light. In each of 6 predetermined sections of the drawing, a slot in the concealed black paper allowed the light to shine through and activate a photoelectric cell, which was connected to the EEG recording apparatus. Every time the pencil passed over a slot, a distinct "on-off" signal was recorded. This furnished data on the rate of drawing and provided an accurate synchronization of EMGs with position in task. The Ss were not aware of the slots in the black paper, nor of the photoelectric cell. Although the pencil light was directly observable, it was readily accepted as part of the experimental apparatus.

Sphygmotonograph. A continuous recording of systolic blood pressure was taken from the left arm with the Cambridge Recording Sphygmotonograph developed by Lange. The purpose was to look for gradients in systolic blood pressure, and for the task-interruption effect in the circulatory system. Because the performance times were too short to allow enough reliable readings, these data will not be discussed. The use of the sphygmotonograph is mentioned because the inflated cuff is slightly uncomfortable for some Ss, and could consequently be a mildly disturbing factor.

Procedure. After the electrodes were attached, the experimental procedure was outlined to S. The test was described as a study of muscle tension during performance

[4]This technique was designed by Mr. R. E. Quilter to provide the required measures of drawing speed without introducing artifacts in the EMGs.

of a motor task. He was asked to do each mirror tracing as well as possible. Each trial consisted of a one-minute pre-period in which S sat quietly and held his pencil on the starting point. Then followed the tracing task, after which there was a one-minute post-period in which S kept his pencil on the point last reached (goal point or interruption point) and remained motionless. Following Smith's procedure, and to ensure that S did not feel frustrated when interrupted, the instructions included: "If for any reason you don't finish one of your tasks, don't worry about it."

Results

Drawing Speed

Drawing speed increased during the first half of the task, and decreased during the latter half of the task (see Table I). Peak drawing speed generally occurred in the 33–50 per cent segment of the task. Because drawing speed did not increase progressively throughout the task, any EMG gradients present cannot be attributed to such a factor.

TABLE I

Median Intra-task Drawing Speed, in Millimetres per Second (17 *Ss*)

	Part of task					
	0–17%	17–33%	33–50%	50–67%	67–83%	83–100%
Completed circle and square combined	5.5	12.1	13.3	11.0	9.9	6.7

EMG Gradients

The effects of changing from extension to flexion, or vice versa, could be sufficiently large to obscure possible EMG gradients. For example, EMGs from active forearm extensors increased progressively during the first half of the completed circle, which required mainly an extensor movement, and then decreased somewhat during the latter half, which required mainly flexion. Similarly, flexor EMGs did not increase much during the first half of the circle, which required extension, but did increase during the latter part, which required flexion. Results for the square show similar relations of EMG changes to extension-flexion shifts. These findings indicate that an adequate test for EMG gradients in the active arm during mirror tracing requires that the amount of extension and flexion be evenly distributed throughout the task.

To this end, the geometric mean (to allow for gross difference in levels) was taken of active extensor and flexor, and results for completed circle and square were combined. We see (Figure 2) that mean EMGs of active forearm increased progressively up to the 84 per cent point of the task,

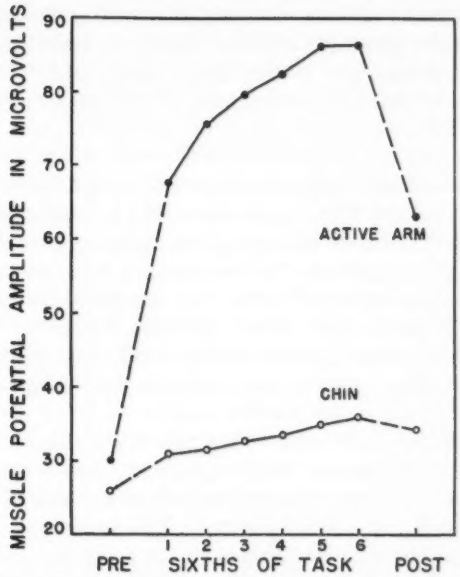

FIGURE 2. EMG gradients for both completed tasks combined. Note monotonic increase in chin EMGs, and increase during most of the task in active arm EMGs.

but showed no change in the last fraction, while EMGs recorded from the chin increased progressively throughout the task. Records of these two types were obtained from about 90 per cent of the Ss. In short, EMG gradients were observed in the chin, where there was no question of overt movement, and in mean forearm EMGs, which took into account extensor-flexor shifts.

Task Interruption

Time intervals sampled were identical with those of Smith (7). Although decrease in EMGs tended to be greater after completion than after interruption, none of the differences between these two conditions reached statistical significance. For example, in active forearm extensors the mean drop within two seconds after completion exceeded that following interruption by 12.6 microvolts ($N = 17$; P only .15). The results on task interruption correlated for the flexors and extensors ($\rho = .62$). In other words, the same Ss tended either to show or to fail to show a differential decrease in EMGs after completion and interruption.

Average EMG rise from the beginning to the 84 per cent point of the task, for *all* tasks combined, correlated positively with the EMG differ-

ence between the conditions of completion and interruption. In other words, Ss with the greatest EMG rise during *all* tasks had the greatest tendency to maintain this tension when interrupted. The correlation ($N = 12$) was .47 for extensor but only .10 for flexor.

Discussion

Present results confirm earlier findings of EMG gradients during mirror tracing (**6, 7**). Forearm EMG gradients cannot be attributed to gradients in drawing speed, because changes in drawing speed did not parallel the course of EMG gradients. Moreover, shifts in extension and flexion were taken into account by showing that combined forearm EMGs increased throughout the task. EMG gradients recorded from the chin were clearly independent of overt movement. Evidence for EMG gradients during attentive listening also indicates that EMG gradients can be independent of movement (**8, 9**).

Present results on task interruption provide a clue to the possible psychological significance of EMG gradients. Lewin postulated that "... the effect of a purpose or intention is the formation of a quasi-need, that is, dynamically, of a tension system. This tension system drives towards discharge and causes activities which serve the execution of the purpose" (**5**, p. 242). If a task with a definite goal is interrupted, the "tension system" remains undischarged. This postulated difference between completed and interrupted activities is supported by evidence for more frequent resumption of interrupted tasks, better recall of interrupted tasks (**5**), and relatively greater maintenance of muscle tension after interruption than after completion (**7**). EMG gradients in forearm extensor correlated positively with the relative maintenance of muscle tension after interruption. The correlation was .60 in Smith's study and .47 for the present one. If we use Fisher's method for averaging correlations from independent samples, we obtain a mean correlation of .55, which for 21 degrees of freedom is significant at the 1% level. Zeigarnik's work (cited by Lewin, **5**) indicated that better recall of incompleted activities was more evident in strongly motivated Ss. The evidence from active forearm extensors therefore supports the idea that EMG gradients may indicate the strength of S's motivation to perform the task.

This interpretation suggests an explanation for our failure to fully confirm Smith's findings on task interruption. As stated earlier, our results on task interruption were in the same direction as Smith's, but were not as statistically reliable. It is interesting to find that the mean EMG rise in forearm extensors for all tasks was 82.7 microvolts in Smith's study, but only 49.6 microvolts in the present study (mean duration of tasks was 33.8 and 32.2 seconds, respectively). This difference was not statistically

significant. However, it was in the required direction if we assume: (*a*) that EMG gradients reflect S's motivation, and (*b*) that Ss in Smith's group were more highly motivated, which would facilitate the demonstration of a difference between completed and interrupted tasks. It may be that there was a sampling difference in experimental population, or some distracting effect of the blood pressure cuff, so that motivation was weaker in our subjects than in Smith's and conditions thus less favourable for demonstrating such a difference.

If research now in progress supports this motivational hypothesis, it may be of value in two respects. On the one hand, the study of EMG gradients may contribute to our understanding of the physiological mechanisms underlying motivation, particularly intensity of motivation. This would require data on the general or selective occurrence of EMG gradients throughout the skeletal musculature. On the other hand, if EMG gradients could be adequately calibrated as measures of motivational intensity, this would be a distinct methodological advantage. In learning experiments, especially, it would be useful to know whether and how motivational strength fluctuates.

Summary

Previous research indicated that muscular activity, measured as electromyographic potentials (EMGs), increased progressively during a motor task. The possible significance of such EMG gradients was examined. A specially adapted ink-writing electroencephalograph, coupled with electronic integrators, provided continuous EMG recordings from active forearm extensors and flexors, and from chin. Seventeen male Ss performed mirror tracings under the two conditions of completed and interrupted tasks.

Mean EMGs in active forearm and in chin increased progressively during the tasks. Drawing speed did not similarly increase; hence EMG gradients cannot be attributed to variations in drawing speed. Extensor gradients, averaged for all tasks, correlated with the relative maintenance of EMG potential after interrupted tasks as against completed tasks. These results suggest that EMG gradients may reflect the strength of S's motivation to do the task.

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CORRECTIONS

1. Professor E. G. Boring has kindly pointed out to D. C. Williams an error in the latter's article, "The New Eclecticism" (*Canad. J. Psychol.*, 1954, 8, 113). The epigram "Psychology has a long past but a short history" originated with Ebbinghaus, not with Brett, as there stated.

2. In Table V of the article by Rosvold and Peters, "Reliability of the closed-field test for rats adapted for water-escape motivation" (*Canad. J. Psychol.*, 1954, 8, p. 143), the column heading "Probability that samples differ" should read "Probability that samples differ by chance."

PERSONALITY CORRELATES OF ELECTROENCEPHALOGRAPHIC PATTERNS: RORSCHACH FINDINGS[1]

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THERE have been many reports describing meaningful relationships between electroencephalographic (EEG) patterns and psychological phenomena in individuals with no known neurological dysfunction (9, 12). However, the findings are not completely consistent, nor is there agreement among workers in the field about the reliability of many of these relationships. This lack of agreement is particularly evident among those who have tried to correlate brain wave patterns with personality and with psychological disorders. Such a situation is not surprising in view of the clinical, rather than experimental, approach that has characterized most of these studies. Clinical appraisal of personality, normal or abnormal, and clinical evaluation of EEG records are both subject to many unknown sources of variability, and generalizations based on unreliable data are likely to be tenuous.

The present study is concerned with the area of personality. It is part of a larger research project designed to apply more refined methods of psychological and electroencephalographic analysis to the relation between brain wave patterns and psychological variables, in the hope that such methods may yield reliable data which will be productive of testable hypotheses and permit comparison with the results of other relevant studies.

In the study of a complex phenomenon such as personality, it is tempting to isolate its discrete components and deal with them one at

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a time. This approach has obvious experimental advantages, but has also the disadvantage that in isolation such components may be distorted, and only remotely related to the basic problem. This consideration prompted the use in the present study of two general approaches in categorizing personality. First, three groups of subjects were so selected that they represented three different behaviour modes of personal and social adjustment, modes which previous reports (**9, 12**) have related to EEG patterns. Secondly, in the light of encouraging results from other studies (**15, 22**), the Rorschach method of personality evaluation was used, together with other tests enumerated below, so that various components of personality could be studied both in isolation and in relationship to each other. The present paper reports the relationships between personality as categorized in the above two ways and EEG patterns.

Methodology

Subjects.

Three groups of subjects were used: 64 consecutive admissions to a provincial psychiatric hospital (Crease Clinic, Essondale, B.C.); 33 inmates of a provincial prison (Oakalla Prison Farm) who had at least two convictions and were free of psychosis or psychoneurosis; and 50 normal subjects selected from among stenographic staff, student nurses, and laboratory technicians at the Mental Hospital, who had neither psychiatric nor criminal histories, and who had been evaluated as successful workers and pleasant working companions by their job supervisors. These made a total of 147 subjects.

The psychiatric patient group consisted of 31 males and 33 females; mean age was 23.86 years. The prison inmates comprised 28 males and 5 females; mean age 22.94 years. The normal controls included 23 males and 28 females; mean age 22.62 years. Age range for the total group was 16 to 30.

Subjects were excluded if they were of subnormal intelligence (below 80 I.Q. on the Full Scale of the Wechsler-Bellevue test), if they had any history suggestive of an organic brain condition, and if they had undergone any physical treatment within the preceding four months which might affect their EEG patterns. The psychiatric patients were examined within 72 hours of admission to hospital, before any treatment procedures were instituted.

Procedure.

Each subject received: an EEG examination with a Grass 8-channel, Model III apparatus, connected and synchronized with an Offner Frequency Analyser; a psychiatric interview; and a battery of psychological tests, including the Wechsler Bellevue Intelligence Scale, Bender-Gestalt, Shipley-Hartford Abstraction Scale, and Rorschach test. All psychological testing was done within 48 hours after the EEG, most of it within 24 hours.

All the patient group were given satisfactory EEG examinations before any treatment procedures were begun. However, 20 of them were too disturbed and uncooperative to be given psychological tests. Hence the relationships to be described between Rorschach scores and EEG characteristics are based on 44 patients, whereas the comparisons not involving test scores are based on 64 patients.

Electroencephalograph Data

Each EEG was recorded, examined, and interpreted according to the usual clinical procedure. In addition, to obtain a precise, objective, and yet comprehensive picture of the frequency aspect of the electrical activity of the brain, an electronic frequency analyser was used. This analyser records graphically the amount of electrical output between two electrodes in a given 10-second period in each desired frequency from one to 30 per second. The analysis is recorded simultaneously with the regular electroencephalogram, and the focus may be shifted to yield an analysis from any one of the eight recording EEG channels.

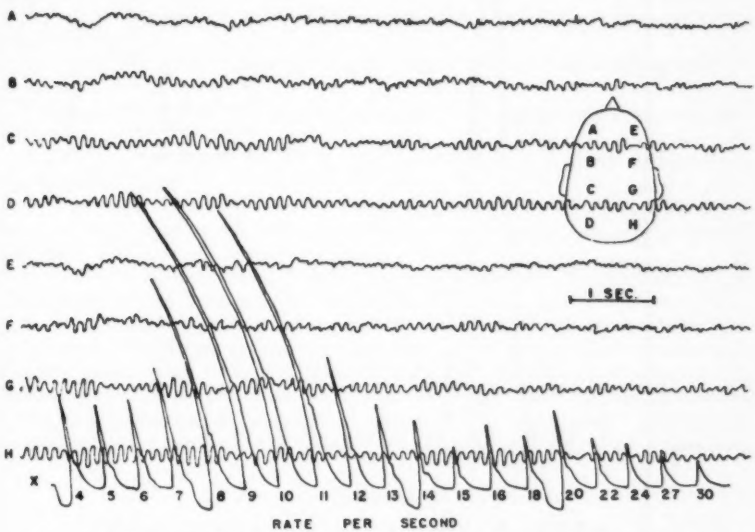

FIGURE 1. A sample EEG record. The lines labelled A through H are the ordinary EEG tracings. The line marked X is the frequency analyser tracing corresponding to channel G. The number beneath each rise in the analyser tracing indicates the specific frequency associated with that rise.

Figure 1 is a small sample of an EEG record. The lines labelled A to H are the usual EEG tracings. The frequency analyser tracing, which here records from channel G, is labelled X. The number below each rise in this latter tracing indicates the specific rate per second associated with that rise. The extent of each rise is a direct index of the *relative* amount of electrical energy output in each frequency as compared to the other frequencies in the specific electroencephalogram.

After the electroencephalogram and electronic frequency analyses were completed for each of the eight EEG channels, the height of each frequency analyser deviation in the record was measured. These measurements were graphed, and resulted in a profile of the distribution and relative amounts of the electrical wave frequencies recorded from the various underlying cortical areas. In the EEG material to be cited here, frequency measurements, obtained by bipolar recording, were used from eight

cortical areas: the left and the right frontal, motor, parietal, and occipital areas. Figure 2 shows the graph profile of a normal control subject. To simplify this illustration, the analyser measurements of only four of the eight channels, those from the left side, are presented. In practice it was found profitable to use different colours and symbols in graphing the eight channels (13).

Careful study of a large number of graph profiles indicated 10 characteristics which provide a useful scheme for describing the general pattern revealed in each

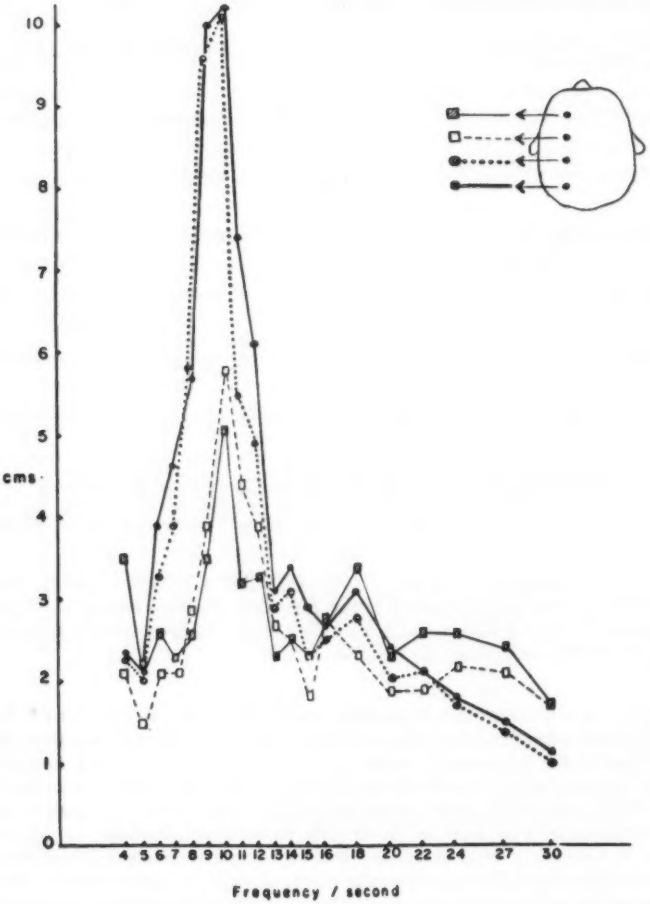

FIGURE 2. A sample graph profile of a normal subject, showing graphically the analyser tracing measurements of four EEG channels from the left side of the head.

graph.[3] These 10 criteria make it possible to compare large groups of profiles. They are defined as follows:

1. *Well organized*: All eight lines run close together with no exceptions to the common direction of progress.
2. *High alpha*: The presence of a distinct rise in 5 of the 8 channels of the alpha (frequency 8 to 12) band, with a single peak and a narrow base.
3. *Peak in frequency 16 to 20*: A sharp upward shift in 5 of the 8 channels in this frequency range.
4. *Peak in frequency 5 to 7*: A sharp upward shift in 5 of the 8 channels in this frequency range.
5. *Peak in frequency 13 to 15*: A sharp upward shift in 5 of the 8 channels in this frequency range.
6. *Spread*: When the 8 lines of the graph run in a band more than 2 centimeters in width.
7. *Poly-peak alpha*: When 5 of the 8 channels in the alpha range show more than one peak.
8. *Peak in frequency 22 to 30*: A sharp upward shift in 5 of the 8 channels in this frequency range.
9. *Poor organization*: When an outstanding characteristic of the profile is the failure of its various lines to converge in any way, where they criss-cross frequently and seem to bear no relation to each other.
10. *Left right dys-synchrony*: Where there is a significant left-right difference in three of the four channel pairs.

The above criteria are in a sense qualitative rather than quantitative. This is in keeping with the frequency analyser data which are of a comparative, rather than absolute, nature. That is, the data allow for appraisal of the electrical output in the various frequency ranges within each *individual* graph. Day to day fluctuations in the critical balance of the analyser apparatus and various other technical considerations[4] make the data unsuitable for quantitative inter-individual comparisons.

Results

EEG Profile Characteristics of the Three Subject Groups

Table I presents the incidence, in percentages, of each graph profile characteristic for the three groups of subjects, as well as the significant t ratios of the differences among these groups. Thirty t ratios were calculated; hence one would expect two of them to be significant by chance alone, using the 5% level of confidence. However, since there were 17 significant t ratios, 14 of them at the 1% level, it is felt that the profile characteristic differences shown in Table I can be accepted with reasonable confidence.

These results may be summarized as follows. (*a*) The psychiatric patients differ from the normals in that their EEGs tend to be less well

[3]A more detailed account of the development of this entire system of evaluating EEG data as well as a comparison of electronic and clinical methods of EEG appraisal will be presented in a forthcoming publication.

[4]See footnote 3.

organized (characteristics 1, 6, 9); show more electrical activity in all frequencies except the 16 to 20 range (characteristics 4, 5, 8); show more tendency to have multi-peaks in the alpha range (characteristic 7); and show more left right dys-synchrony in their graph profiles (characteristic 10). (*b*) The psychiatric patients differ from the prison inmates in that their graph profiles show less organization (characteristics 1, 6); fewer high alpha pictures (characteristic 2); more activity in all frequency ranges except 16 to 20; and more left right dys-synchrony. (*c*) The prisoners and normals differ significantly only in that the former show more high alpha pictures (characteristic 2), and more theta activity (characteristic 4). The only characteristic which yields no significant differences between the three groups is that relating to the frequency range 16 to 20. All three groups have a high incidence of activity in this range.

TABLE I

INCIDENCE, IN PERCENTAGES, OF THE 10 GRAPH PROFILE CHARACTERISTICS, WITH SIGNIFICANT *t* RATIOS OF DIFFERENCES AMONG THE THREE GROUPS

Subjects	Graph profile characteristics (numbered as in the text)									
	1	2	3	4	5	6	7	8	9	10
(1) Psychiatric patients ($N = 64$)	11.36	27.27	86.36	75.00	72.73	63.64	54.55	65.91	45.45	40.91
(2) Prison inmates ($N = 33$)	41.20	58.80	79.40	61.80	50.00	35.30	26.50	23.53	26.50	5.90
(3) Normals ($N = 50$)	38.00	30.00	74.00	36.00	38.00	40.00	24.00	10.00	16.00	14.00
	t Ratios									
(1) vs. (2)	3.20*	3.12*			2.22**	2.73*	3.35*	4.09*		4.76*
(1) vs. (3)	3.36*			4.49*	3.93*	2.58**	3.52*	7.66*	3.64*	3.41*
(2) vs. (3)		2.70*		2.40**						

*Significant at the 1% level. **Significant at the 5% level.

Relations between Rorschach and Profile Characteristics

Each subject's Rorschach protocol was administered and scored essentially as outlined by Beck (1) and the following categories calculated: *R, W%, D%, A%, H%, P, T/1R, F+%, F%, M, Sum C, Sum Y* (computed in the same basic way as *Sum C*), *Sum V* (computed in the same basic way as *Sum C*), and S. With the entire 127 subjects treated as a whole, each of the 14 Rorschach categories was related to the 10 EEG graph profile characteristics. This was done by taking the highest and lowest thirds for each Rorschach category and computing the incidence of the profile characteristics for these two groups of subjects.

Of the 140 pairs of comparisons thus made, only two indicate significant relationships. Those subjects with no *M* responses on their Rorschach record had a significantly greater incidence of electrical activity in the frequency range 16 to 20 (characteristic 3) than did those subjects who had three or more *M* responses (t ratio 2.20, $P<.05$); and those subjects with no *S* responses had a significantly lower incidence of well organized graph profiles (characteristic 1) than did those subjects with two or more *S* responses (t ratio 2.56, $P<.02$). The reliability of these relationships is questionable since, in making 140 comparisons, chance factors alone could account for 7 significant relationships at the 5% level. Thus it would be safer to conclude that there is probably no relationship between any single Rorschach scoring category and the EEG characteristics.

In clinical usage the Rorschach is most valuable when the test results are treated as an integrated whole, and least valuable when single response categories are considered as entities. To apply this integrated approach and still allow for some objectivity, three further analyses of the Rorschach data were carried out to yield the following: an index of maladjustment, based on each subject's entire test record; a rating based on those test responses which are generally accepted as indicative of personal anxiety; and an estimate of experience type (balance of introversive against extratensive personality trends), based on the quantitative balance of *M* and *Sum C* test response categories.

Fisher (6) has developed an index, in terms of pattern criteria, which evaluates "various degrees of personal maladjustment" as indicated in an individual's Rorschach record. This index was calculated for each subject. The mean maladjustment index of the group of psychiatric patients is 48.38, of the normal controls 38.82, giving a mean difference of 9.56 index units. This difference yields a t ratio of 2.50, $P<.02$. To relate the maladjustment index and the EEG graph profile characteristics, the three groups of subjects taken as a whole were ranked according to degree of maladjustment, and the incidence of the ten profile characteristics among the highest and lowest thirds was calculated. Of the ten comparisons thus made, one indicates a significant difference. Forty-five per cent of the subjects whose Rorschach records reflect a greater degree of maladjustment ($N = 42$, index range 50–107, mean 69.07) show the high alpha picture (characteristic 2), whereas only 22 per cent of the group with the lesser degree of maladjustment ($N = 42$, index range 5–33, mean 24.49) show this EEG characteristic. The difference of 23 per cent yields a t ratio of 2.03, $P<.05$. The high maladjustment group consists of 21 patients, 12 prisoners and 9 normals, the less maladjusted group of 15 patients, 9 prisoners, and 18 normals. The previous findings

of reliable graph profile and maladjustment index differences between patients and normals appears inconsistent with the finding of only one EEG characteristic which differentiates the extremes of the index ranking. Also unexpected is the fact that the low maladjustment group includes almost as many patients as the high maladjustment group. This prompted a further analysis.

From among the patient group, those who had been confidently diagnosed as schizophrenic on the basis of clinical history, psychiatric examination, and psychological testing, were selected. This yielded nine subjects with a mean maladjustment index of 58.22. When this group is compared to the normals (mean index 38.82) there is no significant difference between the two mean maladjustment indices (t ratio 1.53, $P>.10$). However, these two groups have significantly different percentage incidences on five of the ten EEG profile characteristics. The schizophrenics show lower good organization (characteristic 1), more activity in all frequency ranges except 16 to 20 (characteristics 4, 5, 8), and more left right dys-synchrony. These five characteristics also differentiate the normals from the entire patient group (Table I). Thus, it appears that the ten graph profile criteria yield meaningful discriminations among subjects more consistently than does the maladjustment index.

Experimental studies (**4, 17**) and clinical experience (**1, 14**) indicate several categories of Rorschach scoring which reflect personal anxiety. Based upon the most general agreement among these sources, five categories were selected: (*a*) responses which use shading (*Y* or *C'*) or texture (*T* or *c*) as the only or the main determinant; (*b*) responses which use colour (*C*) as the only determinant; (*c*) responses which ascribe movement to inanimate objects (*Fm*); (*d*) responses which use vista (*V* or *FK*); and (*e*) the presence of two or more card rejections. From among all the subjects, those whose Rorschach protocols contained three or more of the above five criteria were selected as an *anxiety* group. All the remaining subjects were considered *non-anxiety* for purposes of this phase of the analysis. This procedure resulted in an anxiety group made up of 13 patients, 5 prisoners, and 11 normals; total 29. The non-anxiety group consisted of 31 patients, 28 prisoners, and 39 normals; total 98. Table II presents a comparison of these two groups with regard to the incidence of the ten EEG graph profile characteristics. The results indicate that the graph profiles of the anxiety group, as compared with those of the non-anxiety group, are more often poorly organized (characteristics 6, 9), more likely to contain theta activity (characteristic 4) and fast frequency activity (characteristic 8), and more frequently show multi-peaks in the alpha range (characteristic 7). All these characteristics also differentiate the psychiatric patients from the normal controls

TABLE II

INCIDENCE, IN PERCENTAGES, OF THE 10 GRAPH PROFILE CHARACTERISTICS, WITH SIGNIFICANT *t* RATIOS OF DIFFERENCES BETWEEN ANXIETY AND NON-ANXIETY GROUPS

Subjects	Graph profile characteristics (numbered as in the text)									
	1	2	3	4	5	6	7	8	9	10
Anxiety group ($N = 29$)	20.69	24.14	72.41	72.41	62.07	58.62	51.72	44.83	48.28	27.59
Non-anxiety group ($N = 98$)	29.59	35.71	76.53	50.00	50.00	39.79	27.55	22.44	19.38	19.38
t ratio				2.30		1.82	2.35	2.21	2.86	
P				$< .05$		$< .07$	$< .02$	$< .05$	$< .01$	

(Table I), even though the anxiety group is made up of almost equal numbers of patients and normals.

To establish introversive and extratensive personality trends the ratio of Rorschach *M* to *Sum C* scorings was used. From among all the subjects three groups were selected as follows: (*a*) An introversive group, made up of individuals whose *M* score was at least three times their *Sum C* score. This comprised three patients, five prisoners, and seven normals, a total of 15 subjects whose *M*/*Sum C* ratios ranged from 3.00 to 8.00, with a mean of 3.80. (*b*) An extratensive group, made up of individuals whose *Sum C* score was at least three times their *M* score. This group consisted of three prisoners and five normals, a total of 8 subjects,

TABLE III

INCIDENCE, IN PERCENTAGES, OF THE 10 GRAPH PROFILE CHARACTERISTICS, WITH SIGNIFICANT *t* RATIOS OF DIFFERENCES AMONG THE INTROVERSIVE, EXTRATENSIVE, AND STABLE GROUPS

Subjects	Graph profile characteristics (numbered as in the text)									
	1	2	3	4	5	6	7	8	9	10
Introversive group ($N = 15$)	46.33	46.33	60.00	46.33	53.67	33.33	20.67	13.33	27.67	20.67
Extratensive group ($N = 8$)	25.00	25.00	87.50	62.50	37.50	62.50	50.00	25.00	37.50	0.00
Stable group ($N = 11$)	9.09	0.00	100.00	81.81	63.63	54.54	45.45	54.54	27.27	9.09
	t ratios									
Introversive vs. stable	2.26*	3.57**	3.17**	2.08*				2.36*		

*Significant at 5% level. **Significant at 1% level.

whose *M/Sum C* ratios ranged from 0.18 to 0.33, with a mean of 0.28. (*c*) A stable group, made up of seven patients, one prisoner, and three normals, a total of 11 subjects, whose *M/Sum C* ratios ranged from 0.86 to 1.33 with a mean of 0.99. Table III compares these three groups for the ten EEG graph profile characteristics. The introversive group differs from the stable group in that their profiles show more harmonizing of activity from the various cortical areas (characteristic 1), more high alpha pictures (characteristic 2), and less activity in the frequency ranges 16 to 20, 5 to 7, and 22 to 30. No significant differences appeared between the extratensive group and either of the other groups. However, in view of the small number of cases in the extratensive group, it would be incautious to assert that no relationship exists between extratensive personality trends and the graph profile characteristics. It is also interesting, although not surprising, that there are no patients whose Rorschach *M/Sum C* ratio indicates clear extratensive personality trends.

Discussion

Comparison of the EEG data from the psychiatric patients with those of the normal group indicates a strong tendency for the patients' EEGs to show more activity in the theta and the fast frequency ranges, and less inter-relatedness of activity between the various cortical areas. These findings confirm the observation by previous workers that gross differences in personal adjustment, in the absence of any neurological dysfunction, are related to EEG patterns.

The prison inmates' EEGs are essentially like those of the normals except that they show more high alpha and more theta activity. Several studies have related theta activity with aggressive psychopathic personalities (**8, 10, 15**). Others (**19, 20**) have reported that passive and receptive personality trends are most striking in people with the greatest alpha activity. It is interesting that at least one study (**16**) associates the theta pattern with shy, immature, schizoid types of personality that, at times, show symptoms of aggression. Thus the subjects who make up the prisoner group in the present study tend to have the EEG features of passive receptive persons who are subject to aggressive acting out. Both these characteristics are typical of immature personality organizations, and fit in well with the belief of Hill and his associates (**8, 9, 10**) that the EEG patterns of such people reflect a failure in biological maturational processes brought on by both genetic and acquired factors. It would be of great interest to study longitudinally a group of young people who are basically passive and subject to aggressive acting-out in order to obtain direct evidence, at both behavioural and physiological levels, regarding the maturational hypothesis.

In the present study there are no reliable relationships between single Rorschach scoring categories and EEG patterns. This is consistent with the report by Wishner (22). Fisher's maladjustment index (6) is also unproductive of meaningful Rorschach correlates of the EEG patterns.

When, however, those subjects whose Rorschach responses indicate anxiety are compared with those whose responses fail to do so, the EEG patterns are significantly different. The features which differentiate these two groups are much the same as those which differentiate the psychiatric patients from the normals. This suggests that anxiety may be important in explaining the EEG patterns seen among the patients. Such a hypothesis is supported, with regard to the fast and slow frequency activity and the poly-peaks in the alpha range, by the work of Ulett *et al.* (21), Brazier *et al.* (2), and Finley (5).

The present results suggest that, in addition to the EEG features which have emerged from previous studies, anxious persons and psychiatric patients show less inter-relatedness of activity between the various cortical areas. This observation demonstrates an advantage of the graph profile method of EEG analysis. When the data from each of the eight recording channels are integrated to make up a composite picture, the design of the activity among different cortical areas becomes obvious upon even casual inspection of each graph profile.

In the present series those subjects whose Rorschach scores point strongly to introversive personality trends show well organized EEGs with a relatively large incidence of high alpha. This finding is contrary to that of Henry and Knott (11) who found no alpha differences between introverted and extraverted subjects. However, Saul, Davis and Davis (20), and Davis and Davis (3), have pointed out relations between passive personality trends and high alpha indices which would tend to support the present findings. Our method of determining introversion (*M/Sum C*) is akin to the psychoanalytic approach used by these latter authors, and quite different from the appraisal method used by Henry and Knott (Nebraska personality inventory). The *M/Sum C* ratio was considered by Rorschach to reflect "the manner in which the individual experiences [*erlebt*], but not how he actually lives [*lebt*]" (18, p. 94). The paper and pencil personality inventory is more likely to deal with *lebt* than with *erlebt*, and this could account for the differences in results.

From the material reported here it is possible to formulate two general statements which summarize the conclusions and point the way for future study:

1. The use of a precise objective method of EEG frequency analysis yields data which support the observation that EEG patterns of psychiatric patients as a group differ from those of non-patients as a group. It is

hypothesized that personal anxiety may be the feature of personality organization which is most closely related to certain EEG characteristics of the patients.

2. Our results suggest that people with strong aggressive and passive, or introversive personality trends show the EEG characteristics of high alpha and high theta activity. It is possible that this psycho-physiological constellation is related to maturational processes, an hypothesis which could be examined by longitudinal studies.

Summary

Differences in EEG frequency patterns among psychiatric patients, prison inmates, and normal controls have been demonstrated by the use of electronic frequency analysis of electroencephalograms. Some correlations between personality characteristics, as reflected in the Rorschach test, and EEG frequency patterns are reported, and hypotheses for further research into relationships between EEG patterns are discussed.

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AN EXPERIMENTAL INVESTIGATION OF PERSISTENCE IN SECONDARY SCHOOL BOYS[1]

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"PERSISTENCE" is the quality about which information is most often sought by English Local Education Authorities who use estimates of personal qualities in their procedures for transfer from primary to secondary school (11). However, a conscientious classroom teacher, faced with the task of rating 40 pupils on a 5-point scale for persistence, may well wonder whether the quality is sufficiently generalized to be scaled, or is actually specific to specific situations. The present investigation examines two main problems: to what extent can performance in a battery of persistence measures be explained by common factors independent of abilities; and, what is the nature and relative importance of these factors?

A comprehensive survey of previous research on this quality of sticking to a task once undertaken indicates that:

1. Correlations between persistence tests have usually been low but positive. The few factor-analytic studies suggest a common factor running through ideational measures of persistence. Two studies on American college students suggest another common factor running through physical measures of persistence. Several studies suggest one or more non-cognitive factors common, not only to persistence tests, but to these and groups of other tests as well.

2. Persistence measures usually have very low positive relationships with intelligence and age, up to the young adult level.

3. Ability at specific tasks is slightly and positively related to persistence at these tasks (provided that the tasks appear to the subject to be within his ability range).

4. There is little or no relationship between persistence and perseveration.

5. Success at a specific task encourages persistent behaviour at the task, but a mixture of success and failure at initial stages may further increase persistence.

6. Persistence measures are usually related to school success, the relation being roughly in proportion as the measures resemble school situations.

[1]Condensed from a thesis presented in partial fulfilment of the requirements for the degree of Doctor of Philosophy in the University of London, 1951. The investigation was aided by a grant from the Research Fund of the University of London.

7. Persistence tests do not usually correlate as highly with persistence ratings as do the ratings among themselves.

8. Persistence in group situations may be affected by the performance of other members of the group.

9. Initial motivation influences performance on persistence tests.

10. Persistence is approximately normally distributed in unselected populations.

To attempt to draw together various theories of the relationship of persistence to personality is hazardous, for they are often based upon differing assumptions and definitions. There is a measure of agreement, however, that persistent behaviour is to a considerable extent influenced by degree of general personality integration or stability—by Webb's "w" (**21**), Maller's "c" (**10**), Cattell's "C" and "G" (**3**), and by the reverse of Eysenck's "neuroticism" (**5**). As a second, somewhat lesser, influence upon persistent behaviour, there is some resemblance between Lewin's "dynamic power of the unfinished task" (**9**), Flugel's "self-sustaining needs" (**6**), Cattell's "J" (**3**), and Eysenck's "introversion" (**5**), in that all refer to a sort of obsessional tendency. Vernon (**20**) represents diagrammatically this theoretical relationship of persistence to two main personality dimensions.

For this investigation a simple theoretical framework was adopted. Four approximate levels in an hierarchical organization of personality were assumed—specific responses, habits, traits, and trait syndromes—with personality viewed as the integration of all of these behaviour patterns or tendencies, representing an individual's characteristic adjustments to his various environments. Persistence was defined as that quality by virtue of which an individual continues in steadfast pursuit of an aim, in spite of difficulties or obstacles. It was viewed as probably belonging at the trait level of personality organization, and primarily related to general stability, but having some relationship to introversion, intellect, and physique.

The plan of attack in this study included setting the hypothesis that persistence is a well-generalized trait, selecting a variety of test situations in which persistence might be expected to show, administering these tests to a sample of secondary school boys, and studying the resultant data by factor analysis.

Collection of Data

Measures used. Since the results of factor analysis are essentially expressions of the relationships between performances of subjects in various test situations, selection of the latter is a critical step in a factor-analytic investigation. The criteria governing selection for the present

study are implied in the characteristics of the 21-test battery finally adopted. These may be stated as follows:

1. The tests appeared to measure persistence, and included the more promising persistence tests reported by other investigators.

2. The battery included a variety of personality assessment methods, both individual and group; it covered abilities in a variety of fields, and tapped a variety of interests.

3. Of the 21 tests, 15 were objectively scoreable.

4. The purpose of the tests was not apparent to the subjects.

5. The tasks appeared to the subjects to be reasonably within their ability.

6. Materials and instructions were standardized for all subjects, and substitute activities were provided, where needed, for subjects who decided to quit a test.

7. The measures were experimentally independent.

8. The battery was administratively practicable.

These were the persistence measures used:

P1. Progressive Matrices Time No. (group). An intelligence test based upon geometrical designs (12). A series of numbers displayed at front of room indicated time from start in minutes, and Ss recorded time-number showing each time they wrote an answer. Score: highest time-number. Substitute activity: pencil-and-paper puzzles.

P2. Story Reading (group). Adapted from a test used by Hartshorne, May, and Maller (8); story became, typographically, progressively more difficult to read. Score: time spent. Ss invited at intervals to get an easier story.

P3. Word Building Time No. (group). An anagrams test adapted from that used by Thornton (18). Score: highest time-number. Ss invited periodically to try another anagrams test.

P4. Passalong Test (individual). Adapted from Alexander's Passalong Test of practical ability (1); involved moving coloured blocks of wood about a tray to a prescribed position. *E*, at first meeting with each *S*, rated him on persistence at this task, on a 9-point scale ranging from "Careless–anxious to quit task" to "Analytical worker–intelligently persistent."

P5. Numerical Ingenuity Time No. (group). An adaptation of French's Number Series Test (7); Ss told some problems insoluble. Score: highest time-number.

P6. Japanese Cross (group). A difficult but interesting three-dimensional wooden puzzle similar to that used by Hartshorne, May, and Maller (8). Score: time spent. Ss invited at intervals to try wire puzzles.

P7. Chess Board (group). A jigsaw-type puzzle. Score: time spent before asking for another similar puzzle.

P8. Magic Square (group). A numerical puzzle similar to the Magic Square Test of Hartshorne, May, and Maller (8), entailing constructing a 16-cell square of numbers which sums the same vertically, horizontally, and diagonally. Score: time spent. Ss periodically invited to try a Magic Word Square.

P9. Arm Extension (group). Similar to a test reported favourably by Ryans (15). *S* asked to stand with preferred arm held sideways from shoulder, heels together, other arm at side. Score: time till arm dropped.

P10. Study Time (group). Score: time spent studying a page of printed materials, to answer later test questions on content.

P11. Addition Ratio (group). Ss spent 25 minutes doing simple addition combinations. Score: ratio of number of sums done in last five minutes to number done in first five.

P12. Block Design (individual). An adaptation of a test used by Rethlingshafer, (13). S allowed to start building a prescribed design with blocks, interrupted, and later allowed to return to task. Score: rating on an 11-point scale with respect to degree of refusal to be interrupted, ranging from "No refusal, no resumption" to "Complete refusal to be interrupted."

P13. Breath Time (individual). Followed Thornton's procedure closely (18). Score: time, over two trials, S would hold his breath.

P14. Maintained Handgrip (individual). Followed Thornton's procedure closely (18). Score: total time, over four trials, S would hold a hand dynamometer at two-thirds of his maximum grip.

P15. Foot and Chair (individual). Similar to a test reported favourably by Eysenck (5). S, sitting upon a chair, held one heel just above another chair. Score: time until heel touched chair, summed for two trials, one with each leg.

P16. Rating, Teachers. Teachers who already knew Ss asked, after further three-week observation period, to rate for persistence those Ss with whom they felt they were well acquainted, using a five-point scale. Score: sum of three ratings obtained for each S.

P17. Rating, Peers (group). Each S recorded names of one best "sticker" and three next best "stickers" in his class; similarly names of lowest and three next lowest in persistence recorded. In effect, each S rated every other boy in his class on a five-point scale for persistence. Score: mean rating.

P18. Self-Rating (group). Using forced-choice technique each S selected description he thought fitted him best.

P19. Perseverance Rating, School Records. Given by teachers at end of previous school year, as part of routine of school.

P20. P-F Study (group). In cartoons of Rosenzweig Picture Frustration Study (14), one person describes a situation which frustrates another person. S writes first words that come to mind as response of second (frustrated) person. Responses were scored for need-persistence (in which solutions to frustrating problems emphasized).

P21. February School Marks. As index of school achievement, mid-year marks summed for all school subjects on which comparable data from school records available for whole sample, viz., English, mathematics, art, history, geography, science, woodwork. Appropriate attention to means and standard deviations before summing. A similar measure, called July School Marks, covered performance in school subjects for whole school year.

Subjects. After a pilot study these 21 persistence measures were administered to a sample of 120 English secondary school boys, during the period from mid-October to mid-December. This sample consisted of almost all the second- and third-year boys of one school just north of Greater London. The mean age of the sample was 13 years 3 months, the age-range being 12 years 4 months to 14 years 3 months. Intelligence Quotients of the subjects, as measured by the Duplex Series of Ability Tests No. 3 (4), ranged from 70 to 130, with a mean of 102.3 and a

standard deviation of 12.36. The distribution of IQs, as tested by χ^2, did not differ significantly from normal. The accepted requirements for individual or group test administration were carefully adhered to, and an attempt was made to keep initial motivation constant for all subjects. Scores on 21 measures of abilities which might be expected to be related to performance on the persistence measures were also obtained for the sample.

Factor Analysis of the Large Battery

The intercorrelations of the 21 ability measures were factor-analysed, using Thurstone's complete centroid method, with rotation (**19, 17**), and also Burt's group-factor method (**2**). The results of the two analyses agreed in indicating that, in so far as abilities might be expected to have some relationship to performance on the measures of persistence, the subjects could be considered to perform the persistence tests as if they were doing so by means of the following main ability factors: I, general intellectual ability; II, verbal ability; III, spatial-practical ability; IV, numerical ability; V, age-strength. Speed of work did not appear as a separate ability factor. Composite measures of each of these five ability factors were then obtained for each subject.

The scores on the persistence measures were converted to T scores, i.e., scores normally distributed about a mean of 50, having a standard deviation of 10, and a range of 24 to 76 (for $N = 120$). The Pearson product-moment intercorrelations of the 21 persistence measures, and also their correlations with the five composite measures of abilities, were then computed. From the inter-persistence correlations the effects of the five abilities were partialled in turn, so that the final partialled correlation matrix of persistence measures (Table I) represents the relationships between these experimentally independent measures after the influences of abilities, sex, age, geographical environment, and initial motivation, have been held relatively constant.

This partialled correlation matrix of persistence measures was factor-analysed using Thurstone's complete centroid method, with rotation by the two-by-two graphical method (**17, 19**), resulting, after ten rotations, in five significant factors with loadings as indicated in Table II.

Factor I ran positively through all 21 persistence measures, accounting for 34 per cent of the communal variance and 13.9 per cent of the total variance. It was interpreted as a general persistence factor.

Factor II accounted for 18 per cent of the communal variance and 7.3 per cent of the total variance, and had loadings of absolute value above .200 on the following measures:

P4	Passalong Test	+.623
P14	Maintained Handgrip	+.345
P13	Breath Time	+.311
P15	Foot and Chair	+.290
P11	Addition Ratio	+.256
P12	Block Design	+.250
P1	Progressive Matrices Time No.	−.279
P6	Japanese Cross	−.295
P2	Story Reading	−.309
P7	Chess Board	−.373
P5	Numerical Ingenuity Time No.	−.421

Tests showing positive loadings were those in which the subjects had no knowledge of the performance of their classmates, whereas tests showing negative loadings were those in which the subjects were aware of the performance of their classmates. Factor II was interpreted as a bipolar factor contrasting individuality with social suggestibility in situations demanding persistence. After the effects of the general persistence factor have been removed, different boys have reacted differently to working in a group, as compared with working alone. Being in a group has affected persistent behaviour much more in some boys than in others.

In further corroboration of this factor, during the pilot study P9 (Arm Extension) was administered to 15 boys as an individual test, and later to the same boys as a group test. A highly significant increase in both means and standard deviations of scores on this test under group conditions indicated, not only that work in a group influenced persistent behaviour, but also that different boys reacted differently to the group situation.

Factor III accounted for 18 per cent of the communal variance and 7.6 per cent of the total variance, and had loadings above .200 on the following measures:

P16	Rating, Teachers'	+.635
P21	February School Marks	+.501
P17	Rating, Peers'	+.318
P19	Perseverance Rating, July '49	+.260
P3	Word Building Time No.	−.248
P2	Story Reading	−.279
P6	Japanese Cross	−.370
P7	Chess Board	−.402
P8	Magic Square	−.485

The measures showing high positive loadings were subjective measures of reputation for persistence, while those showing high negative loadings

TABLE I

FINAL PARTIALLED CORRELATION MATRIX FOR PERSISTENCE MEASURES

(This table represents correlations between persistence measures after abilities have been kept constant. Decimal points have been omitted. The coefficients in bold type are significant at the .05 level.)

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20	P21
P1																					
P2	−003																				
P3	**014**	152																			
P4	−096	−040	**221**																		
P5	**425**	073	013	−075																	
P6	**170**	**281**	**296**	066	**251**																
P7	095	**272**	**340**	−043	**251**	**628**															
P8	018	**339**	**296**	**276**	**185**	**505**	**511**														
P9	−066	056	118	049	−093	−165	−039	030													
P10	−006	143	**274**	135	−051	−027	031	**261**	228												
P11	−075	−074	142	**325**	−052	082	090	150	043	005											
P12	001	−108	140	**283**	−095	073	027	083	079	010	037										
P13	−104	−110	**320**	160	−176	−108	−037	056	**194**	132	066	108									
P14	033	−037	**212**	**499**	−016	115	139	**285**	**189**	103	125	106	**239**								
P15	−169	−036	134	**184**	−085	−029	016	070	**368**	139	120	005	**280**	**429**							
P16	−058	−151	160	**318**	008	049	−006	−065	**211**	108	084	042	114	144	134						
P17	032	009	**329**	**219**	078	**246**	**207**	**276**	**278**	**196**	068	−059	036	**255**	**216**	**569**					
P18	004	022	101	−091	075	166	**250**	**241**	−070	074	−068	−041	090	**204**	**038**	−012	061				
P19	001	028	−079	−088	059	088	049	−011	−007	−054	022	031	−089	−050	−136	**385**	108	097			
P20	010	006	**286**	071	001	142	**287**	**333**	**196**	**196**	153	081	050	126	112	**232**	**493**	079	−044		
P21	002	−021	027	054	007	−027	−038	−033	036	082	117	−061	−027	**221**	130	**611**	**413**	032	125	**184**	

TABLE II

CENTROID ANALYSIS OF LARGE PERSISTENCE BATTERY, ROTATED FACTOR MATRIX

(Decimal points have been omitted in the main body of the table. Loadings of absolute value above .200 are in bold type.)

Test	Factor loadings						Factor variances						
	k_1	k_2	k_3	k_4	k_5	k_6	k_1^2	k_2^2	k_3^2	k_4^2	k_5^2	k_6^2	h^2
P1	009	**−279**	164	**518**	122	062	000	078	027	268	015	004	392
P2	**201**	**−309**	**−279**	−107	−008	−001	040	095	078	011	000	000	224
P3	472	094	**−248**	074	061	**−301**	223	009	062	005	004	091	394
P4	**407**	**623**	−045	**222**	−082	012	166	388	002	049	007	001	613
P5	098	**−421**	111	**492**	110	124	010	177	012	242	012	015	468
P6	**525**	**−295**	**−370**	**264**	−180	173	276	087	137	070	032	030	632
P7	**515**	**−373**	**−402**	182	−037	019	265	139	162	033	002	000	601
P8	**584**	−146	**−485**	146	060	−052	341	021	235	021	004	003	625
P9	188	090	154	−171	**295**	**−372**	035	008	024	029	087	138	321
P10	**250**	−037	−048	−128	178	**−295**	063	001	002	016	032	087	201
P11	**240**	**256**	−027	115	−143	−063	058	066	001	013	020	004	162
P12	129	**250**	−054	155	−069	−013	017	062	003	024	005	000	111
P13	116	**311**	−124	−082	**306**	**−222**	013	097	015	007	094	049	275
P14	**459**	**345**	−021	128	**408**	−011	211	119	000	016	166	000	512
P15	**236**	**290**	048	−113	**430**	**−214**	056	084	002	013	185	046	386
P16	**574**	111	**635**	−193	−194	025	330	012	403	038	038	001	882
P17	**603**	−125	**318**	−001	−103	**−412**	364	016	101	000	011	170	662
P18	**206**	−152	−138	−043	**232**	101	042	023	019	002	054	010	150
P19	**226**	−179	**260**	−151	−082	**304**	051	032	068	023	007	092	273
P20	**438**	−126	000	033	−117	**−463**	192	016	000	001	014	214	437
P21	**390**	055	**501**	−148	−024	013	152	003	251	022	001	000	429
						Total	2.905	1.533	1.604	.903	.790	.955	8.690
						Mean	.139	.073	.076	.043	.038	.045	.414

were objective measures of the time which the individual was willing to spend at a task. There are no doubt qualitative aspects of persistence which few objective measures can assess, since any quality of a person must be viewed in its relationship to other qualities. On the other hand, subjective estimates suffer from the defect of "halo." Factor III was interpreted as a bipolar factor contrasting reputation for persistence with objectively measured persistence. This does not mean that in the over-all assessment of persistence subjective estimates varied inversely with objective measures (many show significant positive correlations in Table I). It does indicate that, *after* the effects of general persistence and social suggestibility were removed, a third factor resulted from a combination of the superiority of subjective estimate in assessing certain qualitative aspects of persistence, and of its inferiority in respect to halo-effect. The emergence of Factor III in conjunction with the other factors emphasizes the complementary nature of quantitative analytic procedures and qualitative synthetic procedures in the study of personality.

Factor IV accounted for 10 per cent of the communal variance and 4.3 per cent of the total variance, and had positive loadings on all the spatial and numerical tasks. It had loadings above .200 on these measures:

P1	Progressive Matrices Time No.	+.518
P5	Numerical Ingenuity Time No.	+.492
P6	Japanese Cross	+.264
P4	Passalong Test	+.222

Since the effects of abilities were largely partialled out, Factor IV probably represents an interest in spatial and numerical tasks, such as would be found in the technical stream of a school; it was interpreted as spatial-numerical persistence.

Factor V accounted for 9 per cent of the communal variance and 3.8 per cent of the total variance, with loadings above .200 on these measures:

P15	Foot and Chair	+.430
P14	Maintained Handgrip	+.408
P13	Breath Time	+.306
P9	Arm Extension	+.295
P18	Self-Rating	+.232

Factor V is clearly physical in nature.

These five factors together accounted for about 37 per cent of the total variance of the 21-test persistence battery. (A sixth factor, initially accounting for 2.8 per cent of the total variance and of doubtful signifi-

cance, was retained to assist in rotation. It was interpreted as an error factor). The relatively large percentage of the total variance left to specific factors may be due in part to the low validity of some of the tests as measures of persistence.

The pi-Battery

From the large battery of persistence measures, eight tests were selected on the basis of high communalities, variety, and high loadings on the general persistence factor; hence these eight tests might be expected to possess higher average validity, as persistence measures, than those of the large battery. These tests (P3, P4, P6, P8, P14, P16, P17, P20) were called the pi-battery. The partialled correlation matrix (i.e., intercorrelations after ability influences were held constant) for the pi-battery was factor-analysed using five different procedures. The results of all five methods were similar, and indicated three significant factors very similar in nature to the first three factors emerging from analysis of the larger battery. The results of the unrotated centroid analysis of the pi-battery were chosen as most convenient for our purpose. They are presented in Table III.

TABLE III

Centroid Analysis of pi-Battery, Unrotated Factor Matrix

Test	Factor loadings			Factor variances			
	k_1	k_2	k_3	k_1^2	k_2^2	k_3^2	h^2
P3	.482	.133	−.023	.232	.018	.001	.251
P4	.525	−.354	.396	.276	.125	.157	.558
P6	.411	.382	.026	.169	.146	.001	.316
P8	.616	.520	.292	.380	.270	.085	.735
P14	.491	−.205	.365	.241	.042	.133	.416
P16	.467	−.479	−.317	.218	.229	.101	.548
P17	.743	−.114	−.444	.552	.013	.197	.762
P20	.475	.117	−.311	.226	.014	.097	.337
		Total		2.294	.857	.772	3.923
		Mean		.287	.107	.097	.491

The analysis of the pi-battery provided experimental evidence in answer to the two main questions of this investigation. For this sample:

(*a*) About 49 per cent of the variance in a valid battery of tests designed to measure persistence can be explained by the presence of common factors, independent of abilities.

(*b*) The boys can be considered to have performed on this battery as if they were doing so by means of: (1) a general persistence factor

accounting for about 58 per cent of the communal variance and about 29 per cent of the total variance of the battery; (2) a bipolar factor contrasting social suggestibility with individuality in situations demanding persistence, accounting for about 22 per cent of the communal and about 11 per cent of the total variance; (3) a bipolar factor contrasting reputation for persistence with objectively measured persistence, accounting for about 20 per cent of the communal and about 10 per cent of the total variance; (4) specific factors accounting for about 51 per cent of the total variance. Analysis of the larger battery had indicated that the most important of the lesser group factors were in the nature of persistence at spatial or numerical tasks and persistence at physical tasks.

For each boy, his unweighted *T* scores for each measure of the pi-battery were summed. These summed scores, again *T*-scaled, were called pi-scores, and provided a measure of the general persistence factor for each boy. (The pi-scores, of course, had zero validity as measures of the second and third factors.)

The reliability coefficient of the pi-score, determined by correlating actual scores on two halves of the pi-battery and using the Spearman-Brown prophecy formula, was found to be .748; using Spearman's formula for the correlation of sums (16) and the Spearman-Brown prophecy formula, the coefficient was found to be .795. The reliability coefficient of the pi-battery may therefore be taken as .77, and its index of reliability (the square root of the reliability coefficient) as .88. Having regard for the genesis of the pi-battery, the degree of internal consistency of the battery may be taken as the extent of its validity as a measure of persistence, so that its empirical validity may be considered as .77 and its theoretical validity as .88.

Table IV presents some correlations of the general persistence factor, as measured by the pi-score. None of these correlation coefficients is corrected for attenuation. It will be noted that the correlation of about +.3 between general persistence and school marks is little affected by partialling out general intellectual ability. The multiple correlations of

TABLE IV

SOME CORRELATIONS OF THE PI-SCORE

(*r* of .180 significant at .05 level)

Age	+.048	Feb. Schl. Mks. with Gen.	
Gen. Intell. Abil.	+.188	Intell. Abil. partialled out	+.273
Feb. Schl. Mks.	+.327	July Schl. Mks. with Gen.	
July Schl. Mks.	+.303	Intell. Abil. partialled out	+.242

general intellectual ability and three persistence measures (Teachers' Ratings, Peers' Ratings, and Maintained Handgrip) with February School Marks and July School Marks were +.767 and +.742 respectively, representing increases of +.210 and +.128 over correlations of intelligence alone with these school marks.

The pi-battery can be administered in three group sittings of 75 minutes each and one individual sitting of 15 to 45 minutes.

Summary

Twenty-one measures of "persistence" were applied to 120 English secondary school boys and the results factor-analysed. A strong general persistence factor emerged, and was found to contribute, along with intelligence, to school achievement. The most important subsidiary group factors influencing persistent behaviour were: (*a*) a factor indicating that different boys reacted differently in individual situations requiring persistence, as compared with group situations where the subject could compare his performance with that of his fellows; and (*b*) a factor contrasting objective measures of persistence with ratings on the trait. For measuring the general persistence factor in normal adolescent boys an 8-test battery has been evolved which had, for this sample, a validity coefficient of .77 (theoretical validity .88), and which is administratively practical for research purposes.[2]

It is felt that this investigation may assist in the rating of persistence by throwing further light on its nature, and that measurement of this quality at the trait level can contribute to the understanding of the personalities of secondary school pupils.

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[2]The author will be glad to supply detailed descriptions of the tests and analyses to readers wishing to experiment further with the battery.

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TEACHERS' ADJUSTMENT AND TEACHERS' ACHIEVEMENT IN UNIVERSITY COURSES

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THE PURPOSE of this study is to investigate the relationship between teachers' adjustment and teachers' achievement in university courses. The types of adjustment and achievement investigated will be indicated by the discussion, in sections 2 and 3, of the instruments used to measure them.

The procedure adopted was to obtain various measures of adjustment and achievement for two specific groups of Alberta teachers, neither of which was randomly selected, and by correlative analysis to examine the relationship between adjustment and achievement. The first specific group (subsequently termed Group A) consisted of approximately 120 Alberta teachers enrolled in a summer course in Mental Hygiene (*Education 309*) and Guidance (*Education 307*) at the University of Alberta in 1951. The second specific group (subsequently termed Group B) comprised approximately 100 Alberta teachers registered in Mental Hygiene and Guidance (*Education 308*) in the 1953 Summer Session of the University of Alberta.

A number of investigators have failed to find a significant relationship between adjustment and scholastic achievement. Schmidt (**10**) found that veterans previously diagnosed as psychoneurotic did not differ in scholastic achievement from normal veterans, when intelligence was held constant. Griffiths (**4**), using the Bell Adjustment Inventory without holding intelligence constant, found no significant relationships between adjustment and achievement in university courses. Stagner (**11**) found that "linear correlations of intelligence, achievement, and personality measures are low and are probably so as a result of the inherent nature of the relationship." He suggests that "extreme personality trends seem to counterbalance advantages in aptitude, making for equal achievement in opposed groups."

On the other hand, some investigators have demonstrated a positive relationship between certain personality variables (perhaps related to adjustment) and academic achievement. Thus, Oates (**7**), Ryans (**8**), Edminston and Jackson (**2**) all found low but positive correlations between persistence and scholastic achievement. Ryans (**9**) further found persistence related to emotional stability. Eysenck (**3**) quotes an un-

published study by MacArthur[1] and concludes, "persistence tends to show slight correlations with intelligence, more impressive ones with 'w' or lack of neuroticism, and with introversion." Kimball (6), using sentence completions as a measure of negative relations to father and of aggressive feelings, found significant differences between an intelligent, maladjusted, scholastically failing group and a "normal" group in a boys' preparatory school. Hadley and Kennedy (5), using a sentence completion test devised by Murray and MacKinnon, concluded that "there is real (although slight) evidence here that emotional conflict as indicated on this test is a factor to be considered in accounting for low scholastic achievement in persons of above-average indicated aptitude."

Measurement of Teachers' Adjustment

Group A. Adjustment for this group was measured by the Rotter Incomplete Sentences Blank (I.S.B.). This instrument, the nature of the adjustment measured, the reliability of scoring, and its validity have been discussed in a previous paper (1).

Group B. The instrument chosen to measure adjustment for Group B was the Minnesota Multiphasic Personality Inventory (M.M.P.I.). This inventory is sufficiently well known to make discussion of it unnecessary. The present study was limited to examination of the social withdrawal, depression, masculinity-femininity, and schizophrenia scales as indicators of adjustment. No attempt was made to combine these scales into a single measure of adjustment or to identify characteristic profiles or patterns; each was considered separately.

Measurement of Teachers' Achievement

Group A. As measures of achievement in university courses, the over-all university average and the final grades in *Education 307* and *Education 309* were used. It was recognized that the over-all university averages could not be considered comparable measures of achievement among the group of teachers, since they comprised grades in a diversity of courses taken over varying periods of time. The final grades in *Education 307* and *309*, though limited in scope as measures of achievement, had the advantage of being strictly comparable, since the courses in these subjects were taken at the same time and under the same conditions by all the teachers.

Group B. For this group, only the final grade in *Education 308* was used as a measure of achievement. Again, scope was sacrificed in order to obtain comparability.

[1]Published in this issue of the *Canadian Journal of Psychology* [Ed.].

Results

Group A. Since intelligence is an influential factor in achievement, it was felt that variability in achievement due to differences in intelligence must be eliminated, if a true picture of the relationship between achievement and adjustment was to be obtained. The intelligence of the teachers in Group A was measured by the American Council on Education Psychological Examination. The effect of intelligence on achievement was then eliminated by the methods of partial correlative analysis. With intelligence (as indicated by the A.C.E. raw scores) held constant, the partial correlation between final grades in *Education 307* and I.S.B. scores was found to be 0.11 (S.E. $\pm$ 0.10). With the same variable held constant, the partial correlation between final grades in *Education 309* and I.S.B. scores was found to be -0.02 (S.E. $\pm$ 0.09). Neither of these partial correlations is significant. The simple correlation between university averages and I.S.B. scores was found to be -0.02 (S.E. $\pm$ 0.10), which is not significant.

It is of interest to note that, as a secondary result, the correlation between final grades in *Education 307* and years of teaching experience was found to be 0.25 (S.E. $\pm$ 0.09), which is significant at the 0.05 level.

Group B. The following table summarizes the correlations between final grades in *Education 308* and raw scores on the Si, D, Mf, and Sc scales of the M.M.P.I., together with their standard errors. For all cases $N = 91$.

Scale	*r*	*SE* of *r*
Si	0.04	$\pm$0.10
D	-0.09	$\pm$0.10
Mf	0.21*	$\pm$0.10
Sc	-0.10	$\pm$0.10

*significant the 0.05 level.

Summary

1. For a group of 120 Alberta teachers, no linear relationship was found between their adjustment, as measured by the Rotter Incomplete Sentences Blank, and their achievement in university courses, as indicated by final grades in two courses in Education and by over-all university average.

2. A significant correlation of 0.25 was found between final grades in a course in Guidance and years of teaching experience.

3. For a second group of 91 Alberta teachers, no linear relationship was found between adjustment, as measured by the Si, D, or Sc scales of the Minnesota Multiphasic Personality Inventory, and achievement in uni-

versity courses, as indicated by the final grade in a course in Mental Hygiene and Guidance.

4. A significant correlation of 0.21 was found between raw scores on the Mf (masculinity-femininity) scale of the Minnesota Multiphasic Personality Inventory and achievement in university courses, as indicated by final grades in a course in Mental Hygiene and Guidance, for a group of 91 Alberta teachers.

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Writing Clinical Reports. By KENNETH R. HAMMOND and JEREMIAH M. ALLEN. New York: Prentice-Hall, 1953. Pp. xii, 235. $4.00.

AT LAST we have a book devoted entirely to one of the most vexing problems a psychologist finds when he is required to reduce his judgments and findings to written form. The authors have made a wholehearted attack on this problem, first by evaluating its extent, and then by proposing concrete methods of producing more satisfactory reports.

The authors stress that the aim of a psychological report should be to set forth the psychological findings accurately and forcefully, and in language understood by the person or group for whom the report is intended. Therefore the psychologist must not only understand the person who has been the subject of his investigation, but he must know the degree of psychological sophistication of the recipient of the report. If the report is not suited to the capacities of the reader, the writer's clinical skills are greatly reduced in effectiveness.

The authors feel that no stereotyped outline or report pattern can meet the varying problems and types of readers to whom reports are directed. Hence they endeavour to help the graduate student or practising psychologist develop a method of report writing which is flexible and adaptable to many different situations.

In reading this book, few psychologists will escape the disturbing experience of finding many of their cherished devices and stock phrases exposed to the searching light of critical appraisal. Nevertheless, they will emerge with fresh ideas for preparing more effective reports, and a renewed interest in developing more skill in this aspect of their work.

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Principles of Human Relations: Applications to Management. By NORMAN R. F. MAIER. New York: John Wiley and Sons, 1952. Pp. viii, 474. $6.00.

THIS BOOK has been designed primarily to meet the need of those in industry who wish to gain a better understanding of their human relations problems, and guidance in dealing with them. But there is every justification for the claim that the principles described have equal pertinence to human relations problems in other settings. In keeping with the book's practical aims, theoretical material has been restricted largely to an introduction and a chapter describing a human relations training program.

Subsequent chapters deal mainly with procedures such as role-playing and discussion, ways of attaining group decision, ways of dealing with individuals, non-directive counselling, and methods of evaluating human relations training programs. More than half of the book is devoted to illustrations and cases drawn from the author's own experience in industry. Many of these serve not only to illumine points at issue but provide material eminently suitable for discussion in training programs. Since it is based almost entirely on recent developments in theory and practice, the whole approach to management and supervisor training represents a break with tradition, and many of the techniques described will probably be new to the majority of non-professional readers. The orientation is sufficiently practical to give substantial assistance to those who have specific training responsibilities. They should find this book easy to read, informative, and challenging.

The psychologist who has difficulty in keeping up with his reading of journals in industrial and social psychology will find here many references to contemporary work, and a distillation of much of the current thought on democratic leadership and on training designed to result in altered social behaviour. Some may feel that too little attention has been paid to semantic difficulties; others may feel that the possibilities of sensitizing trainees to group processes could have received greater recognition. But few will fail to appreciate the soundness of this work and its value as an up-to-date text or reference in the area of human relations training.

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Learning Theory, Personality Theory and Clinical Research; the Kentucky Symposium. New York: John Wiley & Sons, Inc. (Toronto: University of Toronto Press), 1954. Pp. ix, 160. $3.50.

PUBLISHED symposia have been growing better and better, and this is a gem. We do not know by what inducements, spiritual or otherwise, the University of Kentucky was able to get eleven eminent and controversial bigwigs to spend two days in the blue grass country lecturing to and at one another. But any psychologist who wants to know what the real issues are between the theoretical Montagues and Capulets of today can find them spelled out plainly, sharply, and wittily in this fascinating little book.

At the head of the learning battalion is Kenneth Spence, who offers a reasoned, modest, and mostly good-tempered defence of those who would construct a psychology by the exact methods of the natural sciences. He

readily admits that the specific laws so far discovered are not yet integrated in any general theory and not yet related to learning in "real" life; whether they ever can be is, he thinks, a matter of faith. What such a psychology will look like is shown by D. D. Wickens, who translates a perceptual set into S-R terms in 11 pages of ingenious and difficult exposition. Wickens' summary begins: "There is a considerable amount of evidence . . . that a one-to-one relationship does not exist between the physical characteristics of a complex stimulus and its stimulating value for the organism" (p. 35). In the light of venerable findings on colour vision, illusions, constancy phenomena *et cetera* this hardly seems news; must we assume that no report by a human subject is "evidence" in the Wickensian sense?

What is wrong with psychotherapeutic theory is devastatingly exposed by Butler of Chicago, who suggests learning theory as an integrating agent among the warring schools, and adds a bonus in a research outline which will be quickly snapped up by Ph.D. candidates. Ammons of Louisville offers a formidable set of postulates for the investigation of "errors," and Wittenborn of Yale urges clinicians to study the process rather than the content of behaviour change, though he is noncommittal as to the adequacy of present learning theory.

Members of the other camp are considerably divergent in viewpoint, but agreed in their emphasis on cognitive processes and their dissatisfaction with the gospel from Iowa. Adams, of Duke, states boldly that, in view of what physics has now become, a sentiment is just as "physical" a notion as a cell-assembly or even an atom, and that psychological laws must use psychological variables. Much of his paper is devoted to lambasting David Krech for his "deplorable apostasy from the insights he earlier attained," and it is intriguing to find this blamed on the Mephistophelian charms of D. O. Hebb. Norman Maier argues convincingly against the "premature crystallization" of behaviour theory, and reports animal experiments which seem to require a perceptual interpretation. This opens the door to Donald Snygg, who is short, forthright, and highly stimulating. He points out the failure of current learning theory to provide a single clue or insight for clinicians, educationists, or other applied psychologists, blames this sterility on our mistaken abstraction of "the" learning process from the rest of personality, and pleads that we put the human being together again by a field approach.

Harlow of Wisconsin has a delightful paper on his now familiar theme: our obstinate neglect of what might be called the "cognitive drives" of exploration and manipulation. He describes striking experiments in which these are the only drives rewarded. O. H. Mowrer hopes to make even the Superego scientifically respectable by borrowing from cybernetics rather

than physics, and suggests interesting applications of the notions of control and feedback. Consciousness, as a "continuous-computing device," would be "logically demanded by the empirical facts even though there were no direct experiential access to it whatever" (p. 84). And finally there is Raymond Cattell, who obligingly rounds out our metaphor by crying "a plague on both your houses!" Castigating learning theorists and clinical researchers alike, he would correct both the narrowness of learning theory and the conceptual woolliness of personality theory by use of multivariate methods of research. It is the first time this reviewer has understood what Cattell is really driving at, and it seems to make sense.

The battle is of course inconclusive and its outcome unpredictable, but it is a stirring battle to watch. And it provides fun as well as illumination: Spence's gentle sarcasms about his critics; Harlow's sallies at the "anxiety-drive" psychologists; Adams' gibes at our spineless deference to neurology; and Cattell's reluctant concession that the "holier than thou" attitude of the learning theorist is at least preferable to the "more popular than thou" attitude of the clinician and the "richer than thou" attitude of the industrial psychologist. Altogether a most rewarding collection.

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Handbook of Social Psychology. Edited by GARDNER LINDZEY. Toronto: Thomas Allen Ltd. 1954. 2 vols. Pp. x, 1226. $15 the set or $8.50 ea.

IT IS interesting to compare the contents of the *Handbook of Social Psychology* published in 1935 with the book now under review published in 1954. Twenty years ago 25 per cent of the handbook consisted of studies of animals below the human level, and another 20 per cent consisted of a broad descriptive account of the social history of the Negro, the Red man, the White man, and the Yellow man. In the book under review only 3 per cent of the contents (and these some of the most important pages in the book) are devoted to animal studies, the remainder being chiefly concerned with the great advances in experimental techniques and procedures that have been made during the past two decades.

In a short review of a book of over 1200 pages it is impossible to do justice to the massive contributions and the valuable sources they provide for research workers. Little more than a summary of the main contents is possible. Part 1 is a comprehensive historical chapter by Gordon Allport in which are traced not only the varied sources from which modern social psychology has been derived, but also the trends, the fads,

and the fashions of interest that have arisen as the subject has been developed.

Part 2 contains a discussion of five contemporary systematic positions –stimulus-response and reinforcement theory, cognitive theory, psychoanalytic theory, field theory, and role theory. In Part 3, with which Volume I concludes, there is an important discussion of different research methods. From a research point of view this is by far the most valuable part of the whole work. It includes chapters on the planning and execution of experiments, on the most useful statistical techniques for handling research problems in social psychology, on attitude measurement, on systematic observational techniques, on sociometric measurement, on the interview, on content analysis, on cross-cultural techniques, and on animal studies.

This last chapter by Hebb and Thompson is of particular interest to Canadian readers. Its treatment differs markedly from that which may be found in the 1935 handbook, in which chapters were devoted to an analysis of the behaviour of bacteria, insects, birds, etc., *per se*. In the words of the authors the chapter has been "largely determined by the look of open astonishment that we have often seen at the idea that the study of animals has any interest for social psychologists." Hebb and Thompson start by showing how the heredity-environment problem in relation to intelligence has been clarified by controlled studies on rats. They then compare what is known about insect language with purposive communication: they compare animal co-operation with human teamwork: they discuss objective ways of recording emotional behaviour; and they discuss practical problems of social motivation, in which the lessons drawn from animal studies are applied to human problems of war, racial prejudice, and child-reading practices. Selective in material this chapter inevitably must be, and some of the conclusions towards the end of the chapter are more speculative than some readers may find comfortable. To me, however, this well written, puckish, and even occasionally impudent answer to the question of what possible interest the study of animals can have for social psychologists was far more stimulating than the dull, sober, and sometimes pedestrian chapters of the 1935 handbook.

The second volume of the Handbook opens with five chapters, which together form Part 4, on the individual in a social context. Here may be found chapters on social motivation, on the perception of people, on socialization, on psycholinguistics, and on humour and laughter. Part 5 has six chapters on group problem-solving, social structure, mass phenomena, leadership, culture and behaviour, and national character; and the second volume concludes with four chapters on the applied areas of

prejudice, mass media of communication, industrial social psychology, and an analysis of political behaviour.

As is inevitable in a book in which the chapters are written by different authors, the points of view, the styles, and the quality vary from chapter to chapter. I have no doubt that those which I have found most interesting, such as Allport's historical introduction, Hebb and Thompson's study of the social significance of animal behaviour, Bruner and Taguiri's chapter on the perception of people, and Kluckhohn's study of culture and behaviour, may be found by other people to be inferior to those chapters which lie closer to their interests. Different preferences are inevitable in a book which attempts to cover the whole field as thoroughly as this. And though I might have been loath to include one or two of the chapters, on the grounds that the relevance of their content to the problems of social psychology had not been sufficiently brought out by their authors, yet the problems involved in producing an important book of this nature are sufficient to excuse one or two minor blemishes.

One might in fact regard this particular problem of trying to obtain a certain amount of unity and integration from forty-six authors as providing in itself an interesting study in group dynamics. I would like to have seen it published as an additional chapter of the book. Had it been possible or practicable, without causing too many red faces, to describe the hazards, the frustrations, the tact, the persuasions, and the final measure of success that the editors must have experienced and put forth in gathering together the material of these two volumes it would, I suspect, have stolen the show.

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The Technique of Psychotherapy. By LEWIS R. WOLBERG. Toronto: Ryerson Press, 1954. Pp. xiv, 869. $16.25.

BASED ON seminars in psychotherapy given by Wolberg at the Postgraduate Center for Psychotherapy in New York, this book represents a comprehensive examination of present-day psychotherapeutic techniques. As he states in the preface, "it describes, in the main, a blended utilization of methods from fields of psychoanalysis, psychobiology, psychiatric interviewing, casework, and psychologic counseling." Throughout he stresses an eclectic approach, and attempts to integrate the work being done by various disciplines. Transcribed recordings of hundreds of treatment sessions, conducted by the author and by therapists of diverse professional backgrounds, provide a wealth of illustrative case material.

Section 1 analyses a multiplicity of therapeutic approaches under the three main categories of supportive therapy, insight therapy with re-educative goals, and insight therapy with reconstructive goals. It also discusses educational, casework, and counselling approaches versus psychotherapy. Included are chapters defining those qualified to do psychotherapy and outlining the education, personality, and experience which the therapist should possess. Throughout, the "teamwork" approach is stressed.

Section 2, 3, and 4 deal respectively with the beginning, middle, and terminal phases of treatment. Much emphasis is given to the initial interview: structuring the situation for the client, formulating tentative diagnosis and prognosis, the values and disadvantages of history taking, and the making of practical arrangements for treatment, referral, or consultation. The treatment process is examined in some detail, including the use of free association, dreams, fantasies, and the handling of resistance and transference.

Section 5 deals with the application of psychotherapeutic techniques to the various neurotic, psychotic, and character disorders, describing the approaches which are, in the author's experience, of most value in each clinical group. He also deals with problems of supervision, recording, and reporting and includes extensive references and recommended reading.

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Educational Psychology. By Robert S. Ellis. Toronto: D. Van Nostrand Company, 1951. Pp. xi, 546. $5.40.

The author of this book has taken the "interest" or "problem" approach in organizing his material. Writing for students in education, he assumes that psychological concepts will be more meaningful if introduced in connection with practical problems encountered in teaching. Some of these problems are revealed in such chapter headings as: The Admission and Classification of Pupils, Their Achievement and Their Elimination from School; The Curriculum; General Principles of Teaching; Observation and the Development of Concepts. This kind of organization, however, has certain disadvantages. For example, the author is compelled to be repetitive, because the underlying psychological concepts overlap into many educational problems. Then, too, material which logically should go together is scattered under various headings—for example, intelligence and its development is dealt with partially in the section on Admission

and Classification of Pupils, but the treatment of measurement and the nature of intelligence appears in a much later chapter dealing with Standardized Tests.

While this book covers a wide range of psychological topics, one feels that it does so in rather a superficial way. The material does not come to grips with some of the more important problems, especially in learning; the discussion of the development of concepts and meanings, for instance, could be greatly strengthened.

On the positive side, the book is interesting to read and should be acceptable to students not particularly concerned with the problems of psychology but wishing a general background for their future teaching activities. At the end of each chapter are a number of questions, as well as a list of references. The author has also included many practical suggestions which the beginning teacher should find very useful.

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Annual Review of Psychology, Vol. 6. C. P. STONE and Q. MCNEMAR (Eds.). Stanford: Annual Reviews, Inc., 1955. Pp. vi, 517. $7.00.

THE 18 fields covered in the latest volume of this useful publication duplicate those of Volume 5, except that an excellent chapter on problem solving and thinking by Taylor and Olga McNemar replaces one on communication. The editors have again secured first-rate contributors; some outstanding chapters are MacCorquodale's on learning, Meehl's on psychotherapy, and Joseph Nuttin's on personality, the last being particularly thought-provoking. In spite of published criticism, only half the bibliographies list the full titles of articles, and there are still no chapters on motivation or perception. Both topics, however, appear in Nuttin's penetrating survey of personality, and aspects of perception are treated under vision by Mueller. Contributors are encouraged, not merely to list the year's researches, but to select, interpret, and evaluate them; this adds greatly to the interest and value of the volume, as does its international scope.

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